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THE TOOL ENGINEER

OFFICIAL PUBLICATION OF THE ASTE AMERICAN SOCIETY OF TOOL ENGINEERS

Departments

Behind every product that is mass produced is the tool engineer

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TABLE OF CONTENTS

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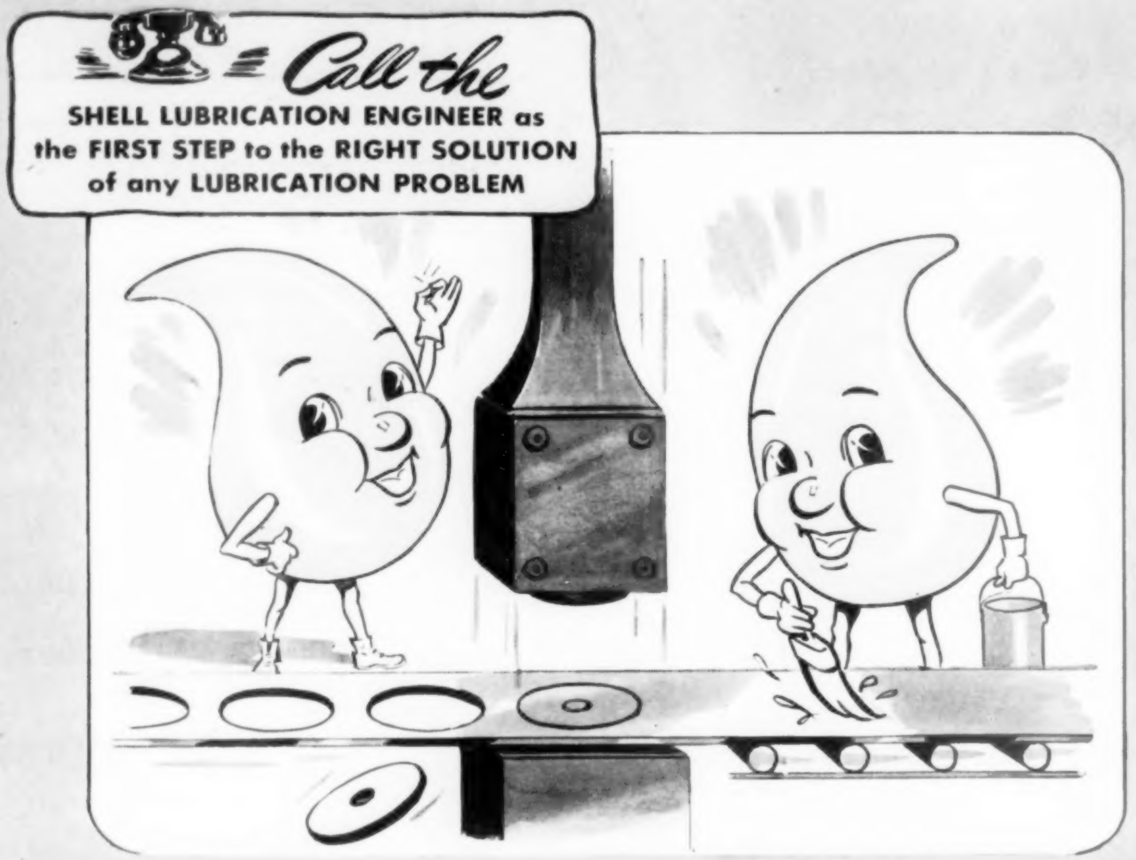

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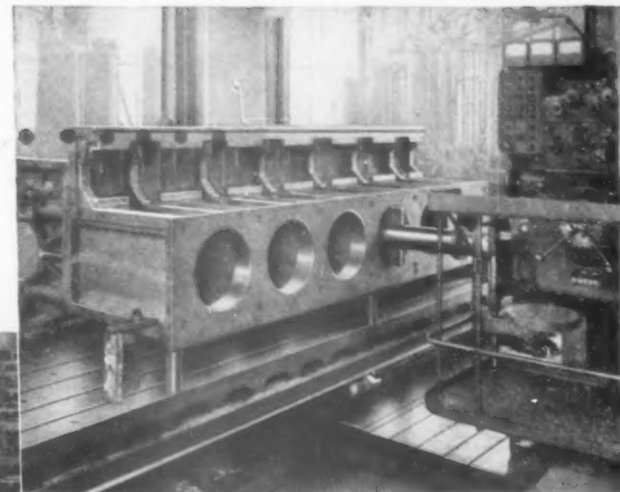
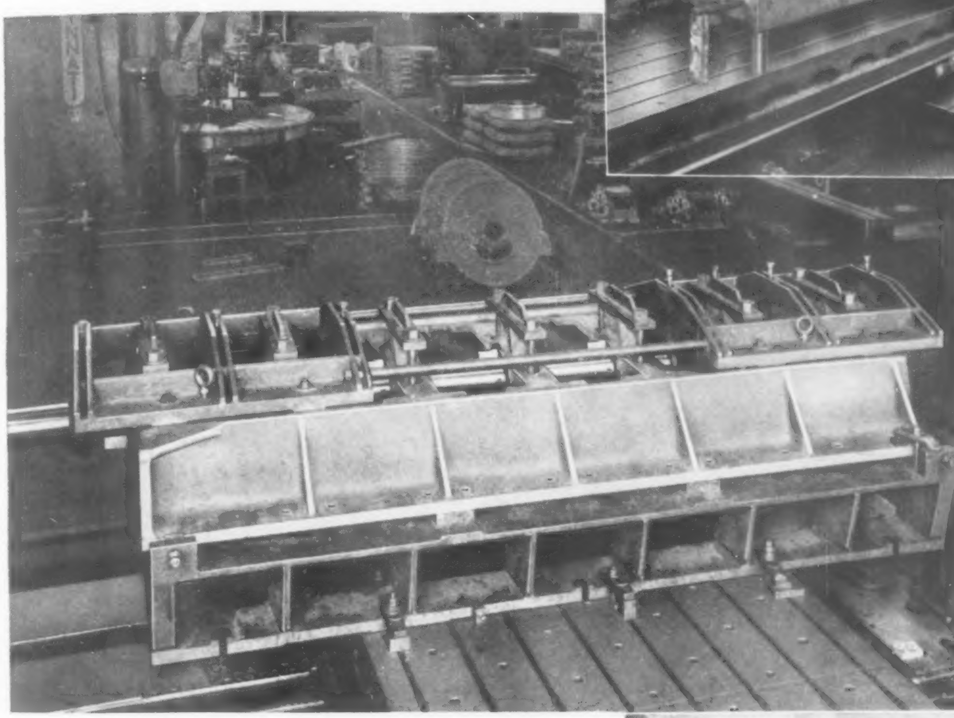
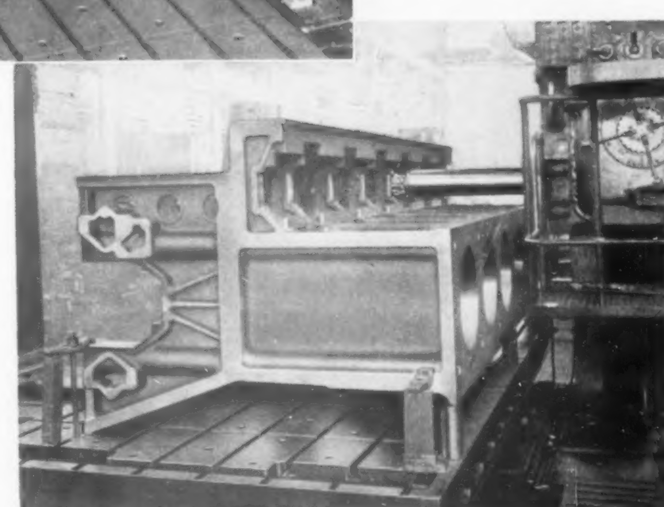


Machine scales and verniers are used to establish hole centers on this six cylinder block. Cylinder liners will be used after boring operations are completed.



Boring seven main bearings simultaneously. Internal bar support fixture is used as shown in this manufacturing operation. To repair and rebore bearings the fixture is not used. Undamaged bearings are bushed to support and align the bar.



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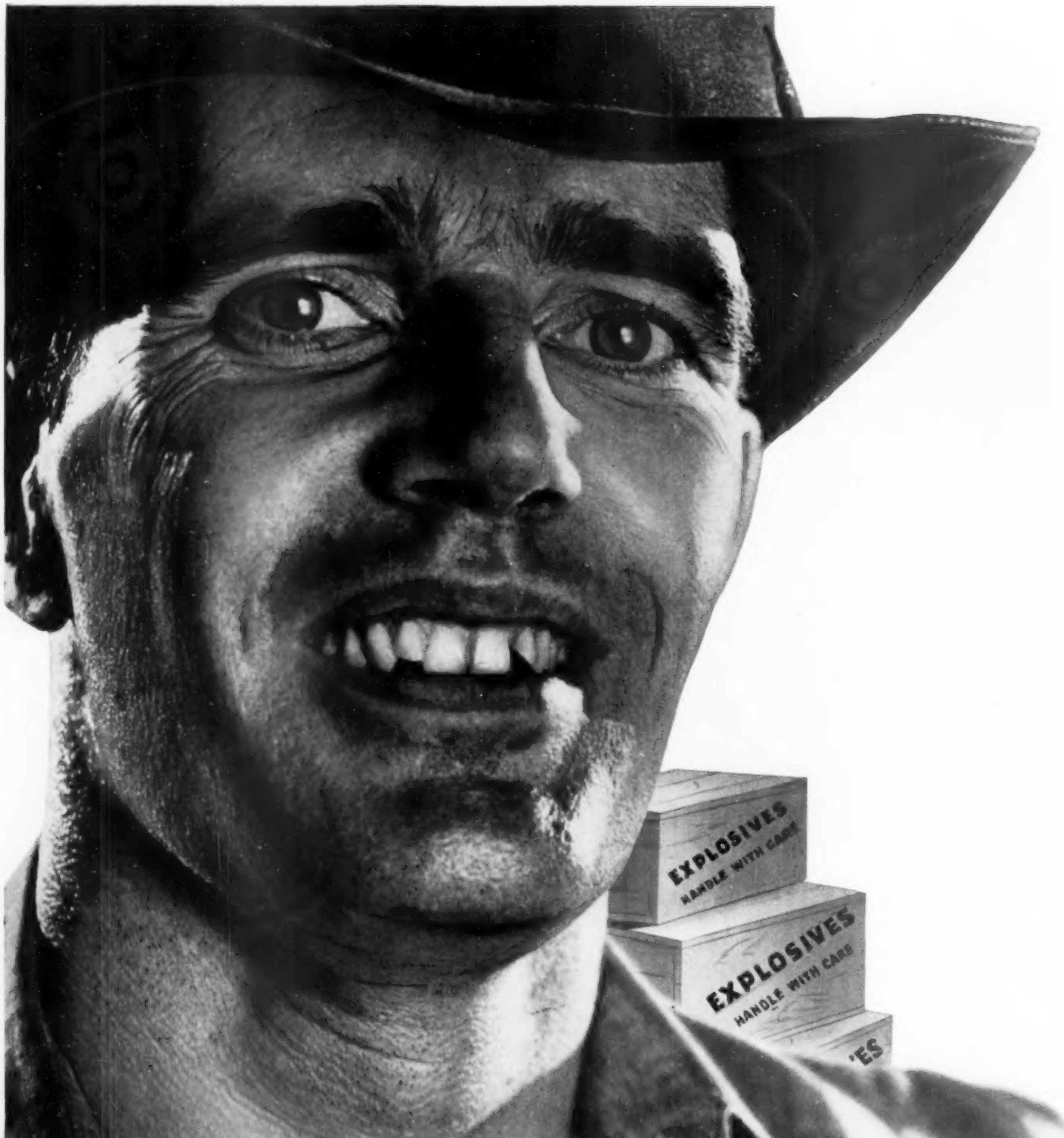
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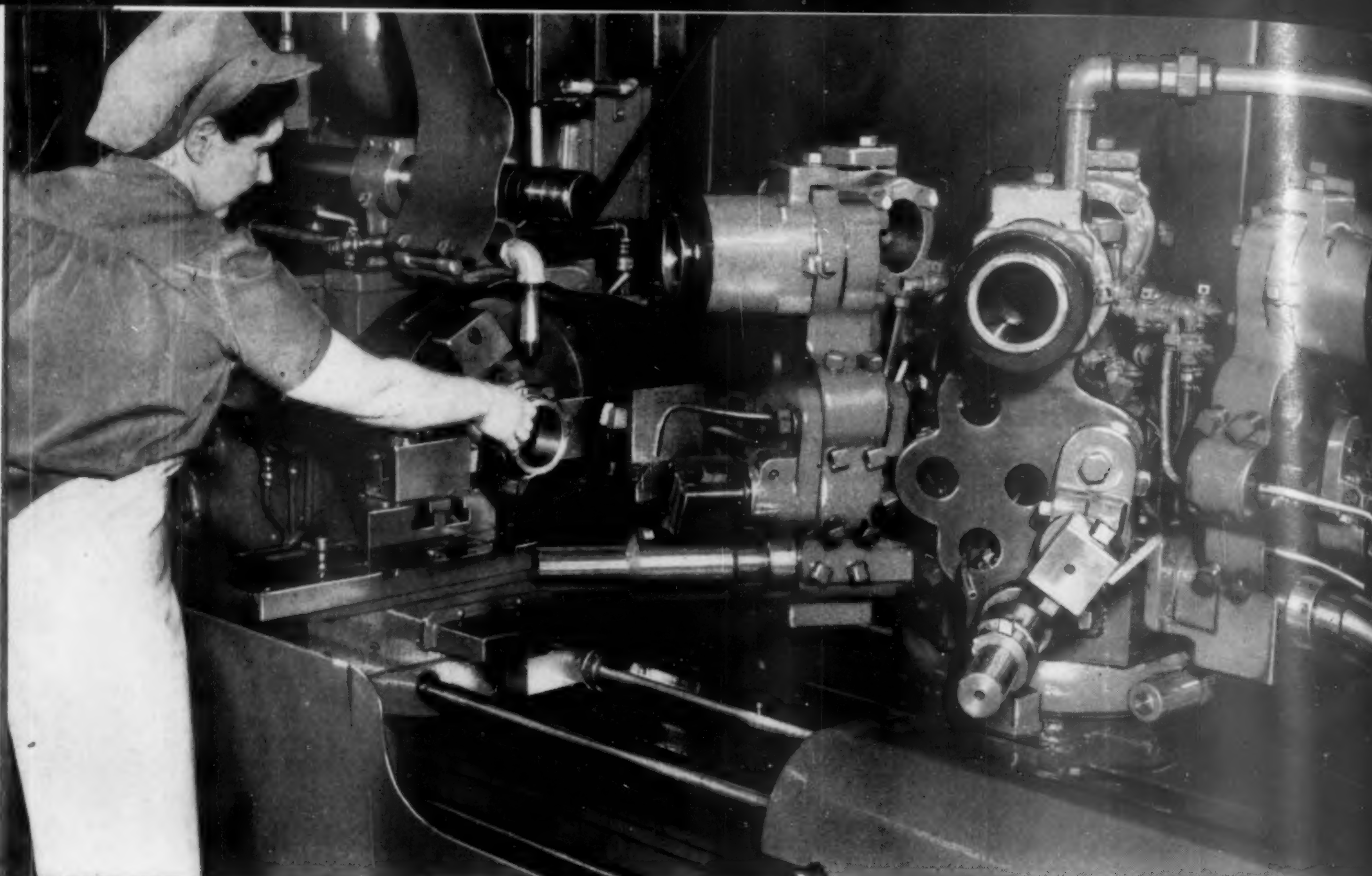

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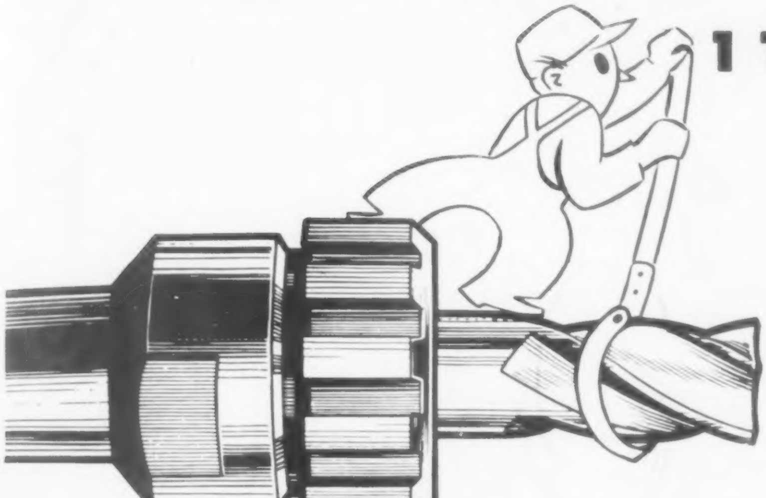

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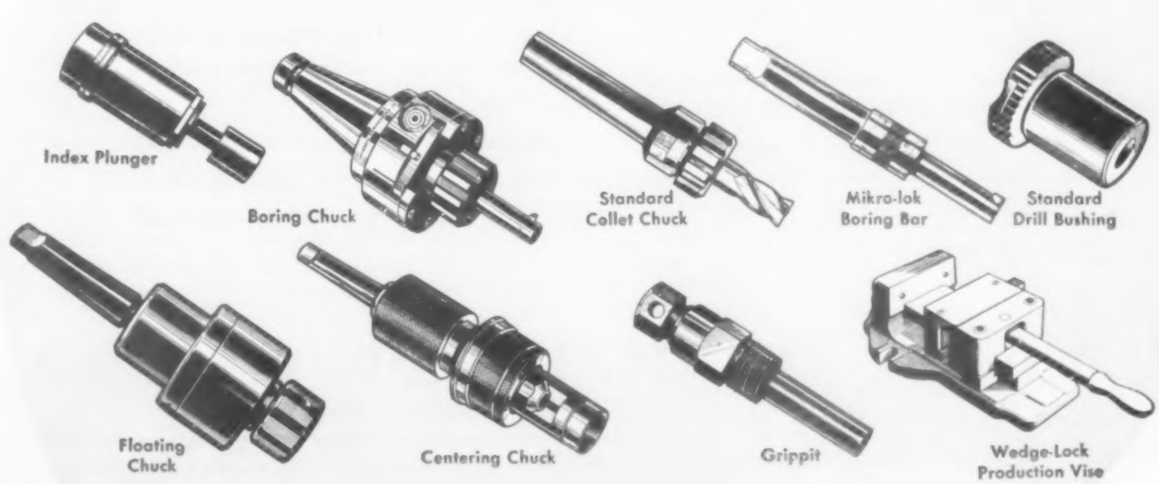

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Editorial

« Industries Must Produce Now and Fast »

IT IS IMPORTANT to our national economy that the American people should think clearly and unemotionally. We must realize that our need for immediate, fast production calls for the highest degree of cooperation on the part of government, industry, agriculture, labor and finance. Because again, as at Pearl Harbor, we stand at the crossroads of national emergency.

Inflation rears its ugly head. Prices in many fields are skyrocketing. Segments of labor and management are always at each other's throats. Alien "isms" are creeping slowly but surely into the body politic. These forces are spurred on by a bitter, radical element of the press, constantly plaguing us with its irresponsible mouthings.

In the absence of constructive programs to combat these evils, our policies are on a day-by-day basis, subject, like restaurant menus, to change without notice.

What we need today in this country is to coordinate our policies through a concerted, intelligent program of public information and education. We must demonstrate to all of the people, after nearly half a century of wandering in the wilderness, that we all strive for the same ultimate ends . . . that our economic needs are basically alike . . . that the only "ism" worthy of our consideration is "AMERICANISM."

No sincere person will represent himself as having the answers to all of our economic ills or an infallible plan that will lead us to the Promised Land. Some principles, however, are basic and should be incorporated into the thinking of every American who would preserve our way of life.

The same natural principles that are applied to tool engineering will provide some of the solutions. This practical science of mass production is one of the few professions in which the practitioner is required to have a fundamental understanding of every phase of economics. It follows, therefore, that the tool engineer's voice will be heard with increasing regard in our economic planning.

To begin with, from our point of view, it is elementary that an economy of scarcity is unsound. The abortive theory of producing less goods for more money, when put into practice, obviously decreases the number of commodities available, and narrows their distribution to fewer people. Standards of living are lowered, not only because there is less to consume, but because the number of workers is depreciated. Unemployment curtails the ability of the public to buy the products and services of business, agriculture and industry. In short, this vicious circle leads us into a tardy economy which, each year, impoverishes our living standards and shrinks effective buying income.

Therefore, we must shun the impassioned arrogance of ivory tower planners who dazzle us with generalities and assurance . . . but never quite get their teeth into their subject. Their eloquent schemes lead to ruin.

We are on safe ground to rely on the invariable law of supply and demand. Our industries must now, of course, produce in abundance to take up the slack brought on by wartime elimination of civilian production . . . and to check inflation by returning us sooner to a "buyers" market. This accomplished, we must produce all that our domestic and export markets can consume in order to provide full employment and further raise our living standards. Under this system only can more people have more things for less money . . . can prosperity be shared by more workers.

The security of this nation is vitally dependent upon the ability of its industries to produce . . . to produce now and fast. We cannot be complacent to the fact that economic disorder is caused by inflation . . . and, more important, that economic disorder is followed by panic, unemployment, political upheaval and revolution.

We must stop the trend toward inflation by returning quickly to an economy of plenty. We must have more cooperation between government, agriculture, industry, labor and finance. Each must harmonize its interests with the interests of the others because only in such harmony can each begin to reach its projected goals and can we re-establish economic security. The sooner supply equals demand, the sooner we will hedge inflation and begin to feel this security.

No greater trust has ever been the responsibility of any generation than that of defending and preserving for posterity the right to live in the freedom of democracy, the privilege which is ours today. We must rally now to the call of greater productivity to insure greater security if our way of life and high standards of living are to be protected.

A. M. Sargent

President 1946-47

A Symposium

Economic Control of Quality*

In Modern Mass Production, Control of Quality Is a "Must" from Receiving to Shipping of Finished Product

Quality Standards and Specifications

By Edward S. Marks

CONTROL OF QUALITY, in production, is a relative term and may have entirely different meanings in different industries. It also has a different meaning when applied to similar precision parts manufactured in large quantities as compared to those same parts produced in small quantities. The problem of maintaining good uniform quality, in production, cannot be solved successfully without giving just as much relative attention to planning as is given to any other part of the producing operations.

The maintenance of good quality cannot be left to chance; rather, each stage from the original conception of the design of the product to its completion and shipment, must be considered important in itself. Inspection functions might generally be assumed to cover those operations which determine whether or not material comes within specifications. Quality control, on the other hand, begins before the inspection operations, goes hand in hand with them and carries on after they have been completed. The more thoroughly quality control procedures and standards are established, before the actual inspection operations begin, the less of spoiled work and possibility of controversy.

Edward S. Marks **is Quality Engineer with Pratt & Whitney Division, United Aircraft, W. Hartfort, Ct. An "old timer" in the precision manufacturing field, he was formerly connected with the Franklin Motor Car Co., Syracuse, N. Y. He is a member of the S.A.E. and Hartford Chapter, A.S.T.E.**

It is the purpose, of this discussion, to describe and illustrate certain activities which have for their object the establishment, control, and the improvement of quality standards and the means whereby they are maintained. To aid in this description, it seems desirable to divide the activities into three phases, namely: the establishment of quality standards; precautions for maintaining; and inspection operations for controlling such standards.

Establishment of Quality Standards

Specifications and drawings should be prepared in such a manner that misrepresentation, from a quality standpoint, shall be reduced to a minimum. In spite of the best efforts of the designers to cover all phases of quality requirements, it is usually necessary—and desirable—to specify quality standards in addition to the information given on drawings and specifications.

When a question arises concerning the acceptability of material, and the final decision has to be based upon opinion, effort must be made right there to reduce "opinion" to a standard which can be recorded and referred to in the future in the same manner in which a drawing is generally used. The following examples of the establishment of standards illustrate what is desirable if the highest quality is to be maintained.

Porosity in Castings

There are two kinds of porosity standards which should be available to the inspector. One is the visual kind uncovered by machining, while the second is that determined by X-ray inspection. In the first case, it is good practice to have samples available illustrating maximum permissible porosity so that the opinion of the inspector cannot vary from day to day and the foundryman will always be in a position to know just what the acceptable standards are. It is also good practice to have available X-ray pictures which illustrate the kind of porosity that will be acceptable and which will not be acceptable. Without such controls, it can readily be seen that the inspection standards will vary from time to time and cause considerable confusion.

Grain Flow of Forgings

Sample forgings, together with photographs showing acceptable and non-acceptable standards, should be available to the inspector.

Magnetic Particle Standards

It is well known that many parts having magnetic indications are acceptable. The basis for accepting such parts has only been established after long experience in knowing what the result of accepting parts with magnetic indications has been. It is now possible to record the character, size and location of acceptable magnetic indications and these are used as a guide by the inspector.

Quality of Plating

Recently, non-destructive methods of testing the bond between the base metal and the plating material have been developed, and it is necessary to give the inspector information concerning these tests together with the acceptable standards.

Repairs

Where experience has determined the exact manner in which acceptable repairs can be made, such information must be made available to the inspector and no other uncontrolled repairs should be allowed.

Surface Finish

Although great progress has been made, in recent years, in controlling surface finish in the shop, and in putting these requirements on drawings, it is still necessary, in many cases, to make certain that standards are established where the drawing does not call for them.

A good way to do this is to have a series of drawings in the hands of the inspectors, which might be called skeleton drawings, where one would be referred to a number of different parts with similar design. The main thing is to have them recorded, if only to avoid controversy.

*Resume of papers, on Quality Control, presented at the A.S.T.E. New Era Exposition, Cleveland, Ohio. Stephen Urban, Syracuse Chapter, Chairman.

Hardness Checking

Rarely does a drawing call for a hardness requirement and at the same time give any allowances which must be used in determining conformation to specifications when considering flat surfaces as opposed to round ones. Inspection instruction sheets should plainly state what these allowances are. Many other examples might be given, but these are sufficient to show the possibilities of creating standards of this character.

Precautions for Maintaining Standards

In order to maintain quality standards, it is essential that those charged with that responsibility be properly instructed. They must not only know how to inspect, but what to look for and what the things they find mean. Not so long ago, the inspector took a drawing, added certain measurements to it, depending upon his own judgment and also used his own methods in doing so. Imagine what would happen, in the complicated production of today, if such a course were followed!

The instructions for controlling the quality of each part should not only be thorough and complete, relative to the specified dimensions, but should contain any additional information that may be necessary for efficient inspection. Therefore, in addition to the usual factory operation sheet used in manufacturing, it is very desirable to have an inspection instruction sheet which is confined to the quality control items.

This can be issued with the drawing and used as a medium for recording quality information not found on the drawing. The same distribution system can be used, for the dissemination of this information, as is used for controlling blueprints. As an illustration of the information mentioned above, two examples given below are pertinent.

Making of parts. Inspection instructions should be given in a way to indicate the manner in which the part should be marked, and the reason for the mark and its location.

Tool marks on heavily stressed parts. Instructions should be so written that the inspector can understand the acceptable character and location of such marks on the part under consideration.

It is very desirable, for the inspection staff, to understand *why* they are asked to do things in a certain manner as well as to know *how* to do them. For this purpose, it has been found desirable to have a regular concentrated course of instruction for inspectors, covering a period of from two to three days and rotating through the department in such a way that all employees may be covered a couple of times a year.

In addition to the information given on inspection instruction sheets, it is also desirable to have available, for reference, an *Inspection Manual* which gives up-to-date information on policies and procedures which are of a general character and, therefore, not applicable to individual parts only. As an illustration, we might cite some examples.

The identification of all important ferrous forgings—as by code letters—has been found to be an essential part of good quality control. This identification should be carried right through all the operations, in order to make certain that the parts are properly heat treated, and should identify the finished part as being made of the proper material. Procedures, fixing the responsibilities of the various departments in maintaining these code letters as they are transferred in process, and spot check procedures for determining the quality of lots of materials where it is not possible to check the finished piece without destroying it, are good Manual items.

Gages and Testing Equipment

By A. E. Rylander

An Exposition of Tools Used for Control of Dimensional Quality.

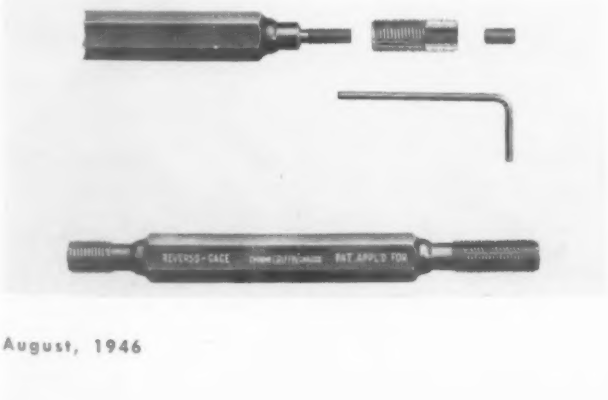
As long as there has been manufacture of consumer goods, reputable producers (and only the reputable can survive) have striven to control the quality of their wares. And while quality is a relative term, as Mr. Marks states, and widely applied to cover raw materials, dimensions, appearance and wearability among other things, it assumed a new and definite meaning with the advent of the microinch and the subsequent development of ultra-precision measuring instruments.

In the mechanical trades, quality and precision are practically synonymous terms. And precision implies measurement, be it in the manufacture of wire, thread, textiles or mechanical products, the compounding of paint, alloys and plastics, the structure and grain flow of metals, heat treating, machining, surface finish and—yes, even packaging and presentation to the consumer trade.

Thus, wire, textiles, plastics, metallic bars and shapes are subjected to tensile and compression tests, shapes to stress anaylsis and structures to microscopic and X-Ray tests. Dimensions, heat, pressures—as of air, gases and fluids—are all measurable by instruments designed for the purpose. Mechanical, air, electro-magnetic and electronic gages control dimensional quality, and one of the latest developments will measure and duplicate color, of paint, to the finest shading of a tint.

We will not take space, here, to go into detailed history of measurement. Briefly outlined, however, the first step in precision measurement, as far as American industry is concerned, came with the introduction of the micrometer caliper, by the Brown & Sharpe Mfg. Co., about eighty years ago. True, measurement to .001"—and finer—had been previously attained, but with cumbersome in-

The Reverso-Gage by Geo. N. Griffin Company 1301 W. Hadley St., Whittier, Cal. When threads wear beyond tolerance, the gage is reversed, doubling life. In addition, a chrome carbide facing greatly extends normal life.



The No. O Dial Bore Gage by Standard Gage Company, Poughkeepsie, N. Y., brings the range of these instruments, by standard, from 12/8" down to ⅜". The gage is furnished with an indicator graduated to .0001" or .002 mm and, although small in size, the tool is claimed to be accurate to within .00002".

The training of inspectors along the lines of specialists is also very desirable because of the inability to obtain sufficient, all-around experienced help. The more simple the task can be made, the better chance there is of getting the inspectors to understand it and to obtain the protection desired.

Where large quantities of duplicate parts are being manufactured, it is possible to develop sampling methods which result in the maintenance of quality by actually doing less inspection than has been done heretofore. For instance, where it has been found that the necessary quality has been maintained by doing a 10% inspection, new sampling methods, based upon the laws of probability, whereby the percent of inspection varies due to the size of the lots and the number of defective parts found, have made a big saving in labor without sacrificing control of quality.

It is also desirable to consider many inspection operations just as important as manufacturing operations from the standpoint of making them easily performed. In every case where it can possibly be done, studies should be made to see if the visual or eyesight method of inspection can be substituted for the "feel" method which requires greater skill and experience.

Good Fixtures Reduce Spoilage

Special attention should be given to the design of fixtures involving dials, to be read, instead of measuring instruments which require expert use of the hands. This, of course, saves labor and, in addition, utilizes a less experienced type of personnel. Inexperienced machine operators make it necessary to conduct inspection operations nearer the point where the operation is performed, and there the inspector can be of much greater assistance to the manufacturing supervisor than would otherwise be the case.

Manufacturing operations should be so planned that an individual operator cannot spoil a piece of work without it being known by his superior. This fact alone prevents the individual from side-stepping his responsibility, and therefore, makes him more conscious of his possible errors. The use of unskilled help, in machine operations, has brought about a condition where it becomes more necessary than ever to have tools designed in such a way that it is not possible for an operator to make a mistake.

Conditions Should Be Studied

It is good policy to have tool designers study existing operations for this purpose only. Their sole duty should be to analyze tooling operations where spoiled work has occurred, for the purpose of making changes in the fixtures, or cutting speeds or feeds—or any other factor which will make the operation more foolproof—and to make it impossible to have the same errors occur again. In making an analysis of the causes of spoiled work, it is very often found that the tooling had no relation to the cause. The carelessness of the operator in many cases can be given as the reason and then a consistent education policy on the part of the supervisor is the answer and should be carried on vigorously.

Very often the quality of rough materials, as received, turns out later to have a big influence on spoiled work. In order to cut this down to a minimum, it has been found very desirable to keep material such as bar stock, forgings, and castings well segregated, throughout their machining operations, into batches which indicate the lot as it has been processed in the foundry, forge shop or mill.

If, at some particular operation, it has been found that defects in the material have caused spoiled work and lost labor, and the nature of the defect indicates that it might be a characteristic of a particular lot of material, plenty of

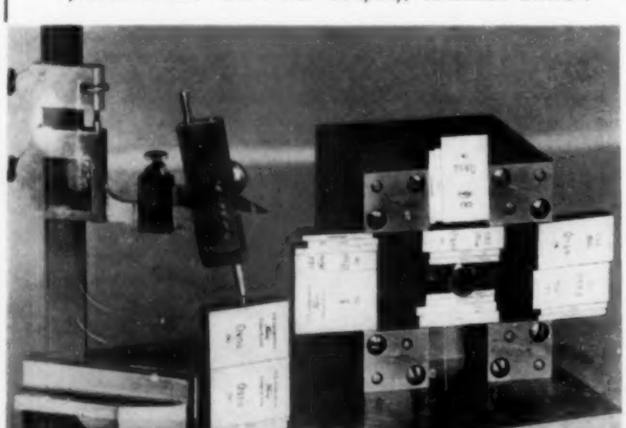
struments; however, the micrometer caliper put relative accuracy into the hands of the machinist and toolmaker.

Indicators of a sort—"wobbler" and multiplying lever —were known before the micrometer and developed into the dial indicator of which the Ames was probably the first to find wide commercial use. These indicators, in turn, have been refined into extremely accurate instruments, marketed under various trade names and obtainable, from almost any of the makers, to accuracies within plus or minus .0001". The Microcator, by the Swedish Gage Company of America, is said to be accurate to within .000002".

In their evolution, however, they were subject to the same variations, between makers, that characterized all measuring instruments of the time. There was no absolute standard of comparison until the advent of the "Jo" Block, invented and pioneered by Carl Edvard Johansson of Eskilstuna, Sweden. The microinch had arrived, and with it a new concept of precision!

These gages were further developed and refined, and their use extended, by the Ford Motor Company (which acquired American rights to manufacture the original Johansson blocks) and by Pratt & Whitney, which developed the Hoke Blocks, and by Webber, DoALL and Jansson Gage Company among others. Consistently accurate and all made to one common standard which, in

Gage blocks have infinite applications for quality control of mass production, and as standard references for fine tool work. Photo shows location on a special gage checked by "Jo" Blocks, product of the Ford Motor Company, Johansson Division.



83-piece set of "Lifetime" Gage Blocks, by the DoALL Company, Minneapolis. Because of a special facing which guarantees especially long life against wear, they do not corrode and have wringability far in excess of unfaced steel blocks.

savings are possible if such a lot can be removed from production. The extra work of transferring identification marks in process might be easily offset by losses due to the inability to segregate and take such lots of material out of production before further time is wasted.

Another vulnerable point, in inspection of rough material, which can result in great reduction of spoiled work if properly handled, is the design and procurement of adequate inspection fixtures. No doubt there are many times when we forget all about rough inspection, without very much attention given to the rough material and fixtures and tools. We leave it a lot to the man's eye and the scale or something like that.

Inspect Rough Castings

Many times, considerable saving could be made if we really went after the rough inspection work the same way we do the finished work. It is a much greater saving to throw out a rough casting than to throw it out after labor has been expended on it. Special tool designers should be assigned to the design of rough materials inspection equipment, having for an object the elimination of castings and forgings which, later on, will have a chance of being rejected because of defects entirely beyond the control of the machine operator.

Intelligent vendor contact is more desirable today than ever before. In many instances, the vendor has never had to meet the requirements now expected of him. Preliminary to making a contract with a new subcontractor, experts in manufacturing processes should visit the prospective vendor's plant for the purpose of seeing if machinery and personnel are adequate for the job.

After the contract is placed, sample pilot lots should be submitted to the regular inspection department for a report. The Receiving Inspection Department must then be so organized that it can carry on from here, through an experienced man, to prevent spoiled work from piling up between vendor and contractor. In this, there is no substitute for personal contact.

Inspection Operations to Control Quality

The less time which elapses between the time when an error is made and the time the operator is informed, the less the chance of repeating this error. This time can only be reduced by keeping accumulation between the operators and inspectors right down to a minimum. It is very often less of an evil to have inspecters waiting for work than it is to allow backlogs to build up and then to find, later, that errors have cropped up in a large number of pieces. Due to the volume of material flow which might vary from time to time, it has been found advantageous to have available a certain number of all-around inspectors who can be shifted from one department to another, as needed.

There are many intricate factory processes, in use in modern industry, which if not performed uniformly and accurately will impair the quality of the finished product. The nature of some of these,—as, for example, certain plating and surface finishing operations—is such that an inspection of the finished part will not determine its quality unless the part is destroyed. In many cases, the control of the quality of this kind of work has been the responsibility of shop supervision.

However, rapid expansion has made it impossible to be sure that shop supervision is alert enough to protect the customer against inferior workmanship. A procedure, which has been successful, involves getting every last detail of the process down on paper in the form of operation sheets which cover all the tricks of handling as well as checks on

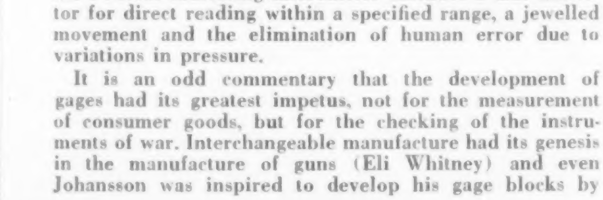
turn, became the international norm, these gages made interchangeable manufacture a fact instead of a comparative term.

From then on—and especially since World War I—development and refinement of gages and measuring instruments has progressed at an accelerating pace. Take the micrometer caliper, as an example. Originally graduated to .001", it was later provided with a vernier, to read to "tenths," and still later provided with a ratchet stop so as to equalize "feel" between various users. Now, the Federal indicating micrometer includes a dial indicator for direct reading within a specified range, a jewelled movement and the elimination of human error due to variations in pressure.

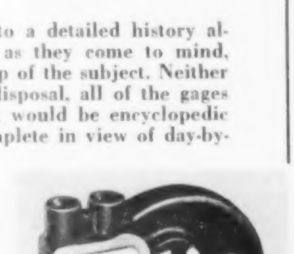
It is an odd commentary that the development of gages had its greatest impetus, not for the measurement of consumer goods, but for the checking of the instruments of war. Interchangeable manufacture had its genesis in the manufacture of guns (Eli Whitney) and even Johansson was inspired to develop his gage blocks by the inconsistencies of gages used to check high power rifle parts.

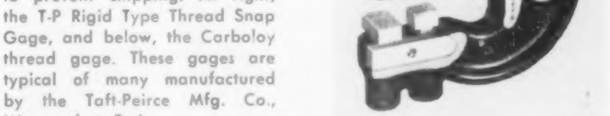
During World War I, the U. S. Government insisted on accuracies, in the manufacture of ordnance and munitions, that were sometimes resisted by industry. Yet, this accuracy was subsequently applied to commercial products—notably automobile parts—and had a profound bearing on the miraculous output of interchangeable parts, by American industry, during World War II. And this, in turn, portends a higher quality of consumer goods, in the years to come, than the world has previously known.

As aforesaid, we cannot go into a detailed history although brief explanatory notes, as they come to mind, may be in order for a better grasp of the subject. Neither can we display, in the space at disposal, all of the gages in use today. Such an exposition would be encyclopedic in scope and could never be complete in view of day-by-



At left, the Emmerton Ball Bearing Plug Gages, in steel and Norbide. Note that the latter (lower photo) has a pilot between the back and the facing to prevent chipping. At right, the T-P Rigid Type Thread Snap Gage, and below, the Carboloy thread gage. These gages are typical of many manufactured by the Taft-Peirce Mfg. Co., Woonsocket, R. I.





materials used. These sheets are then used by inspectors as a basis for a periodic check to see that no deviations are allowed.

After parts have been found to deviate from specifications, a well organized procedure is necessary in order to make certain that every effort is put forth to use the material. The consideration of such material might be conveniently divided into two large groups:—first, material which is spoiled in such a way as to make it immediately obvious to even the less experienced people that it cannot be used and must be rejected.

This class of material does not cause much concern, although the data from it may be used to prevent repetition. The second is that which is of such a nature that consideration should be given to its use. This second class can also be conveniently divided into two further groups, one being that which, after study, can be considered as usable as is, and the other, that which will have to be repaired in order to be used.

Systematic Check an Essential

Any good quality control organization must be so organized and manned that both classes of material receive the very best attention of men experienced in quality standards and the function of the parts in the design of the product. It is essential to have allowable repairs covered by a special set of drawings. Repair work is then inspected to these drawings and is thus under the same control as work which does not need repairing.

In making decisions concerning the use of material which has been repaired, dependability, performance and interchangeability should be considered. The all-important question to answer is: "Will the part be dependable and give the same service as one which has not been repaired?" If the answer is "no," then the other factors do not have to be considered.

Inspection operations must be continually studied to make changes for the purpose of improving quality to reduce cost. A systematic running down of inspection errors, in order to determine causes, very often results in a new method that will automatically eliminate the same error in the future.

The inspection of small parts in relatively large quantities can be greatly improved by changing from portable gaging equipment to stationary as, for instance, where the older methods called for the use of gages and handling the work with both hands.

Thus, it can be readily seen that the recording of quality, either by word description or photography, and taking the necessary precautions to guarantee conformance to them and consistently striving, by means of an organized effort, to improve the standards as well as their control, will result in steady progress toward better products at lower cost.

Fundamentals of Inspection Procedure

By Alfred L. Davis

When the historian of the future has had opportunity to evaluate in true perspective, the production achievements of American industry during World War II, he is almost certain to record as the factors which contributed in greatest measure the advancement in two fields: (1) improvement in the methods of manufacture, and (2) improvement in the techniques of controlling quality of product. The

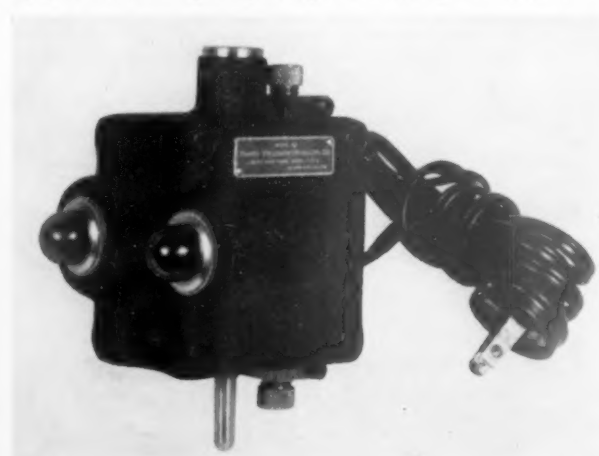
day development and invention. All we can show is typical examples of the types of gages in more or less common use today.

At left, a "Go"—"No Go" Hardness Tester, by General Electric's Meter and Instrument Div'n, West Lynn, Mass., greatly simplifies inspection of watch and instrument parts too small to be production tested with mechanical testers.

Below, the G-E Magnetic Comparator, for checking ferrous parts for quality control, variations in composition, hardness and other characteristics which affect magnetic properties.

Taking these in order as they appear in this "story within a story" and on subsequent pages, we have, on page 19, the Reverso-Gage by the George N. Griffin Company. This type of gage—with variations by several different makers—was inspired by the fact that the major wear, on thread gages, occurs on the first few threads. Entirely aside from other refinements—as improved metal-

Electronic Self-Contained Gage Head, by the Yankee Precision Products Co., 50 Bartholemew Ave., Hartford, Conn. This gage is for direct connection to a 110 V. circuit without the use of transformers, rectifiers or tubes. The spindle is frictionless and contacts are made, without any multiplying leverage, through electrical gas contacts. Approximately 2¾" square, the units may be mounted on a stand or to suit special application. They can be ganged, as closely as ⅞" for multiple gaging. Gaging is indicated by plus or minus lights operating within settings of .00001".



st is almost a direct reflection of the work done by the al engineer and the second is giving recognition to the importance of the quality function and the speed with which this function has developed in the last few years.

Alfred L. Davis was born in Boulder, Col. A graduate of Salem College, W. Va., with an M.A. degree from Syracuse University, he subsequently served as Instructor in Economics and Industrial Management at Rochester Institute of Technology. From '41 to '45, was Chief Inspector, mechanical parts, at Bausch & Lomb Optical Co., then reentered the Institute as Associate Director, Evening School and Extension Division. He is co-author of books on "Economic Problems and Cases" and "Small Measuring Instruments Test," and Vice-Ch'man, B'd of Directors, Rochester Jr. Ch. of Commerce; also, has served as President and Treasurer, American Society for Quality Control.

As a by-product of the speed with which the quality function developed, there has come some confusion in the use of the terms "inspection" and "quality control." For the purpose of this paper it is not necessary that one define the differences between the two, but rather, to think of the procedures to be outlined as being applicable whether the approach is through inspection or through quality control.

First, however, it is necessary to briefly define the scope of the quality function.

The quality function is one of responsibility for *interpretation, control and verification of quality through measurement and/or comparison with engineering specifications.* To discharge this responsibility, it is necessary that inspection procedures be developed in regard to four basic functions:

(1) Providing protection; (2) Maintaining product control; (3) Portraying quality performance; and (4) Educating and training personnel in matters of quality.

I. Function of Protection.

In the performance of its first function, inspection has a two-fold obligation to perform, i.e. it should provide protection to the producer of the product and protection to the consumer of that product.

In many of the plants with which I am acquainted, inspection and quality control men are doing their best work by providing protection to the plant through receiving inspection and to the consumer through internal control of the product and final inspection.

It is important, therefore, that systematic inspection procedures be established for the control of raw materials, i.e. all metals, castings, moulded products, plastics, chemicals and fabrics should be required to pass through an inspection station before acceptance by the plant.

In addition, the quality function should be so defined that it permits inspection to exercise its influence in the matter of specifications. Working in close cooperation with Engineering, Purchasing and the Research Laboratories, inspection should insist upon purchase specifications which are realistic and test methods which are both accurate and economical in their use. It should be a fundamental procedure of inspection to check the specifications to insure that they carry meaning to the vendor as well as being realistic in terms of the needs of the shop. If this procedure is followed, inspection can make a substantial contribution in seeing to it that the plant receives quality protection on the purchasing dollar expended.

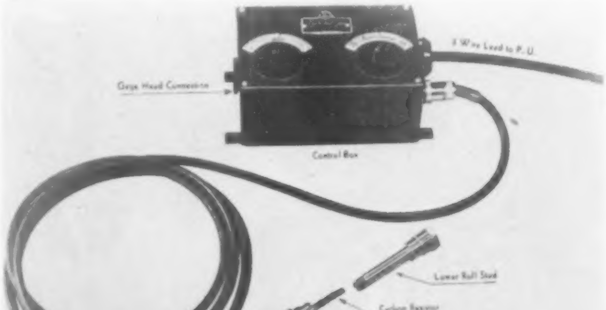
lurgy and chrome carbide facing—the reversing feature doubles the life of the tool.

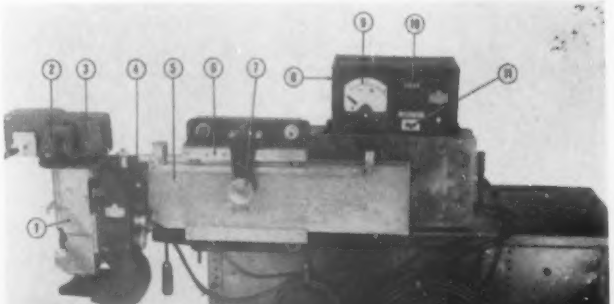
The next photo shows a small bore dial gage, one among many dial gages and comparators produced by the Standard Gage Company. Other makers of dial indicators and comparators include the B. C. Ames Company, Federal Products Corporation, the Compar Company and the Swedish Gage Company of America. As previously stated, these gages have been refined, not only to a high degree of accuracy, but to an almost infinite range of application.

Next, in order, are shown typical precision gages of the "Jo Block" type. The photo at left shows the "Lifetime" Gage Blocks, by the DoALL Company, and the picture at right, (by courtesy of the Ford Motor Company) shows the Johansson blocks in one of the infinite applications for quality control of tools and parts.

Remote Control Unit for use with the P. & W. Continuous Electro-limit Gage. Reading from left to right, lower photo, No. 1 is the Model D Continuous Gage Head (shown at right); 2, the gage head counter; 3, gage head Selsyn motor; 4, cross head; 5, cross slide; 6, rail; 7, sprocket for overhead slide control; 8, remote control cabinet; 9, indicating meter; 10, cabinet counter and, 11, the plus and minus toggle switch.

The Pratt & Whitney Electrolimit Internal Comparator checking both the large and small ends of refrigerator connecting rods as produced from Bryant High Speed Grinders. These gages check size, roundness and taper to "split tenths." May be used in connection with statistical quality control charts.





Effective inspection procedures are equally important to the consumer in providing greater uniformity of product and the knowledge that quality has been *built* into the product. There are many examples, particularly in the food and drug industry, that suggest the importance of this type of inspection. In addition, effective inspection procedures are of paramount importance from the company point of view. Such factors as "good will," satisfaction of the consumers of their product, their profit and loss situation and the companies competitive position are all to a great extent dependent on effective inspection.

II. Function of Product Control

The second function of inspection is that of product control or the term more frequently used today, that of process control.

I presume that some semblance of control can be obtained through an inspection organization performing the usual sorting and screening operations. As the product moves through an inspection crib, the inspector may examine the product very carefully and through adopting the principle, "It shall not pass," obtain a rather high degree of control. Indeed, through an arbitrary exercise of this authority, he can materially add to the uniformity of product by eliminating insofar as possible all known defects. However, you and I know that this is not economical control of quality. Economical control is obtained at the machine. It is process control. Product control means that procedures are devised for controlling the whole quality problem. For example:

(1) Procedures are instituted for proving the design and process—possibly through a pilot model or pilot lot.

(2) Process or floor inspection is instituted to control quality at the machine.

(3) Procedures, such as control charts, are used as means for determining sources of trouble, the cause of a breakdown in quality and any trends which may be developing.

(4) Someone is assigned the task of investigating the unusual variations in quality, establishing responsibility for same and instituting corrective action before defective product is produced.

The thoughtful application of these four points will produce effective, economic control of quality and should be considered among the most important of the fundamentals of inspection procedure.

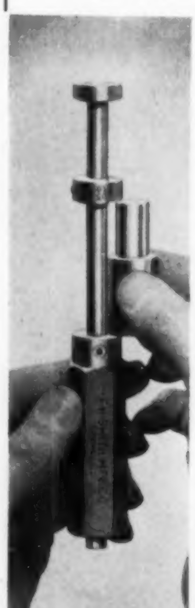
In combination with the above procedures, inspection has a relationship to the gages and special equipment which is used for the measurement and control of quality during the process of manufacture. Quality of product cannot be controlled unless you know and can measure that which you are producing. It is in this area of measurement that the tool engineer can be most helpful to the quality function.

First, *there is a need for more and more direct measuring instruments.* Second, *there is a need for faster means of gaging,* and Third, *there is a need for more accurate and "fool proof" gaging instruments.*

In the first instance, direct measuring instruments are pre-requisites to the control of quality. In regard to the second point, gage manufacturers and particularly those who design and build specialized equipment, should keep uppermost in their minds the question, "Will this device permit economical gaging?" The third point involves the accuracy and "fool-proof" character of gaging equipment. There are still many instruments in common use which are not adequate for precision measurements and which permit a high percentage of error on the part of the inspector.

Many studies have been made on this subject of inspector accuracy. Usually the study has been made from the stand-

On page 21 are shown a few of the many varieties of precision gages made by the Taft-Peirce Manufacturing Company, Woonsocket, R. I. The novel use of steel balls, in the two gages at left, greatly facilitate entry into a bore, while the Norbide (Norton Company) facing on the lower gage greatly extends life and accuracy. The rigid type thread snap gage (small photo) is an excellent example of these "Go"-"No Go" gages, while the Carboloy thread gage, lower right, is typical of interchangeable sets using a common, soft steel handle.



An Adjustable Length Gage (left), by F. H. Smith Mfg. Co., 3043 W. Carroll Ave., Chicago, is designed to check the body lengths of studs. With two limit rings—for "Go" and "No Go"—tolerances from .005" to .020" in multiples of .005" can be selected as required.

Below, the Smith Form Tool Setting Gage, primarily designed for use on Brown & Sharpe automatic screw machines but adaptable to other applications. With this gage, form tool settings may be recurrently duplicated after sharpening. The undercut provides for setting the back tool, as shown.

As a diversion from dimensional measurement, the Hardness Tester (small photo) and the Magnetic Comparator, by General Electric Company, are but two of many measuring instruments developed by G-E. In fact, General Electric, and the Westinghouse Electric & Mfg. Company, have been prominent in the development of electro-magnetic and electronic master units or "brains" used in practically all of the automatic gaging equipment. The photo at lower left shows an electronic, self contained gage head by Yankee Precision Products Company.

Next, in order, is the Air-O-Limit Internal Comparator, by Pratt & Whitney which, as the name implies, employs air as an actuating medium. This gage, and the Electrolimit gage shown at right, is but one of a wide variety of gages, by P. & W., for control of dimensional quality.

A new Small Hole Gage, by B. C. Ames Company, Waltham, Mass., is a 2-contact instrument for checking size, taper and roundness of through or blind holes in tool and die work as well as for production. Range, through changeable contacts, is from 3/16" to 1", with indicator reading in "tenths."

point of rating the inspector on his ability to sort out known defects in a given lot of material. However, one of the most interesting of the recent studies was published in the December 1945 issue of the *Journal of Applied Psychology*, entitled "The Accuracy of Precision Instrument Measurement in Industrial Inspection."*

The Human Element

In the study, inspectors in two different plants were examined. Each inspector was examined on only those instruments which he was accustomed to using. "He was encouraged to make five measurements and then to record his best judgment as to the dimension. The readings thus obtained were compared with so-called 'true' dimensions which were determined by means of ultra-precision instruments in combination with (gage) blocks." In addition, "the instruments utilized in the performance testing were checked and adjusted periodically to insure (their) constancy." The results were startling:

Using the 1" vernier-micrometer—43% of the inspectors obtained readings within the plus or minus .0001" established tolerance. With the 2" vernier-micrometer—17% obtained readings within the plus or minus .0001" tolerance. Using the 6" vernier-micrometer—only 11% of the inspectors obtained readings within the established tolerance of plus or minus .0001", while 89% of the inspectors were in error!

The highest degree of accuracy obtained from among twenty instruments was with the inside micrometer where 66% obtained readings within the plus or minus .001" tolerance. The lowest degree of accuracy came in the use of the inside caliper and measuring over the points with a 6" micrometer. In this case only 9% of the inspectors were accurate with the plus or minus .002" tolerance.

Possibly you would like to charge off all of this inaccuracy to poorly trained inspectors. However, in the study quoted, 45 experienced toolmakers were examined in a similar fashion, using the vernier-micrometer. It is interesting to note the results. If the part was about ¼" in diameter, 73% of the toolmakers were able to obtain readings which were accurate within a tenth. However, if the cylindrical part was 3 inches in size only 12% of the readings were accurate within a tenth.

In summarizing this study, the authors suggested that "The implication is present that the very nature of the vernier-micrometer and similar precision measuring instruments is such that one should not expect as high a degree of constancy as the average operator, supervisor and standards man has been taught to expect."

If this conclusion can and has been substantiated in regard to the precision instruments which are the standard measuring devices of the inspector, it is interesting to speculate upon the degree of accuracy which is built into specialized gaging equipment produced by the tool room of the average shop; the equipment with and by which inspection is supposed to verify quality through measurements. If inspection is to be performed honestly, effectively and economically, one must know what constitutes true quality. This in turn means that one has got to have at his command instruments and gages which will give him this information and give it to him accurately.

Another point to be considered by the inspection group

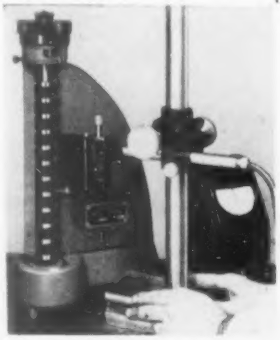
*C. H. Lawshe, Jr., & Joseph Tiffin, "The Accuracy of Precision Measurement in Industrial Inspection." *Journ. of Applied Psych.*, Vol. 29, No. 6, Dec. 1945, Pgs. 413-419.

At left, page 24, is shown an adjustable length gage, by F. H. Smith Mfg. Co., and below, a tool setting gage, for screw machines, both of which save considerable time, besides controlling comparative quality, in the production of bar stock parts. At right is shown a new small hole gage, by the B. C. Ames Company, Waltham, Mass. A precision instrument in every sense of the word, the gage, in turn, is subject to rigid quality control in its manufacture. Other small bore gages are made by Standard Gage Company (previously mentioned, the Federal Products Corporation, Pratt & Whitney and the Swedish Gage Company of America.

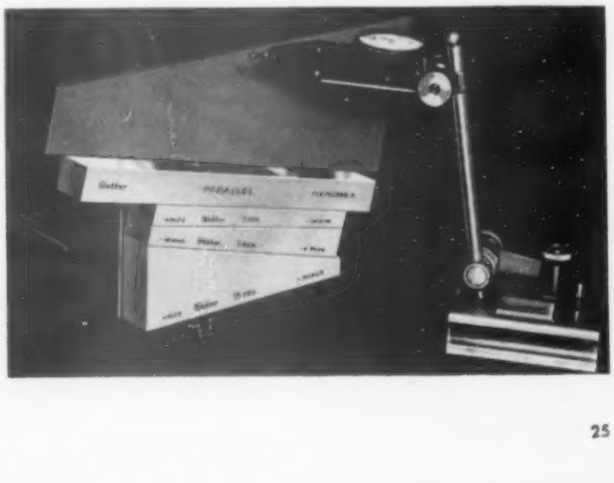
Photo at left, below, shows a combined gage and tool room accessory, for accurate layout and checking of angles, by the Angle Computer Company. In the smaller photo, at right, is the improved Pla-Check, by Cadillac Gage Company, while an application of angle gage blocks, by the Webber Gage Company, is shown at lower right. Just as flat gage blocks are accurate to the microinch, so these angle gages are accurate to the micro-degree.

Latest model Studler Angle Computer, by the Angle Computer Co., 1709 Standard Ave., Glendale, Calif. Designed for precision layout and inspection, the tool may be rotated 360 degrees, in three planes, to obtain exact position to .0001" or to the minute of a degree.

At left, the improved PLA-CHECK, by Cadillac Gage Co., 20316 Hoover Rd., Detroit. New accessories, including a 3" riser, greatly extends the range of this gage.



Below, the Webber Angle Gage Blocks, by the Webber Gage Co., 12908 Triskett Rd., Cleveland. Guaranteed accurate to 1/5, 184,000 part of a circle, these blocks will yield any angle from 0 to 103 degrees—a total of 370,800 angles in steps of one second each.



is the effect of present type gaging equipment on the use of scientific sampling plans. A bit of thought on this point will quickly suggest that the inspector will soon insist upon obtaining gages (that is gages of the conventional type, thread, ring and plug) which are far more accurate than the ones frequently available for use by inspection. They will demand gages which have a minimum gage-maker's tolerance, and which have a minimum allowance for wear. In other words, they will demand gages which are more nearly representative of the true dimension.

The importance of this consideration can be seen from an examination of a simple application of a recognized sampling plan to the inspection and acceptance of a lot of 500 parts, where you are willing to run a 10% risk of accepting a lot which is 5% defective. According to the sampling table, you would take a sample of 110 pieces and if no more than 7 pieces of the sample are found to be defective, you accept the lot. However, if 8 pieces are found, you reject the lot. It can be readily seen that the gage employed in this inspection problem should be one which accurately conforms to the true dimension. The usual allowances for the gage-maker and wear would in most instances be sufficient to cause the rejection of a portion of the number which is permissible under the plan, thereby increasing the possibility of rejecting the whole lot. Any savings through sampling would thus be nullified and a detailed inspection would be required.

Objections may be raised by the gage-maker on the question of reducing his permissible tolerance. The shop may even object to having wear allowances minimized. However, it should be pointed out that gages employed in sampling material are not subjected to the same wear as those employed in the usual sorting or screening, therefore, through less inspection the gage life will still be comparable to that of a gage used for more frequent gaging. Most firms now employ separate sets of gages for the shop and for inspection. Undoubtedly, the shop gages should incorporate all the present wear features. The inspection gages of the future, however, will have to be those of a more accurate character and which have the usual wear and gage-maker's tolerances minimized. They will undoubtedly be obtained through greater accuracy on the part of gage manufacturers, or through more precise gage control in the shop. In either case, it is a problem which the tool engineer cannot lightly disregard.

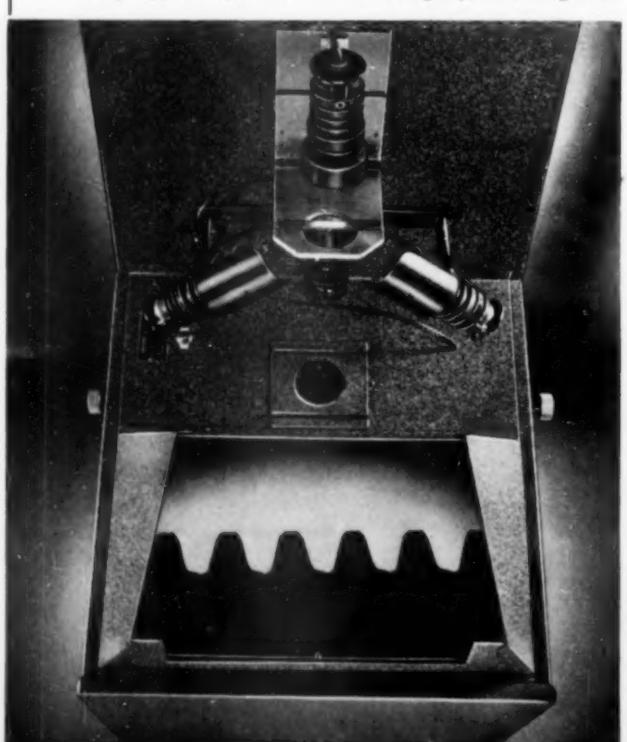
III. Function of Portraying Quality Performance

The third function of portraying quality performance is two-fold. It involves the portrayal of quality at the machine as well as the reporting of over-all results.

The quality control chart is the fundamental procedure used at the machine. It provides graphic means of showing the operator and supervisor as well as the inspector just how they stand on quality as it is being produced. It has been said that one of the greatest advantages to accrue through the use of the control chart is the psychological approach of showing the operator where he has been and where he is going. To the inspector it provides data which can be used immediately. It is the tool which will permit economical inspection control and at the same time enable the inspector to prevent the creation of defective product.

However, there are other inspection procedures required for reporting quality results on an over-all basis. First, objective data should be obtained which will show those operators that are consistently producing quality product and those that are contributing a high percentage of defec-

At left, below, is the Fish-Schurman Optical Contour Comparator, of which the Sheffield Corporation has acquired exclusive sales right. There is a sharp trend toward optical checking of parts and tools, and prominent in this field can be mentioned the Bausch & Lomb Optical Company, Compar-Instrument Company, the Engineers Specialties Div'n of the Universal Engraving & Colorplate Company and the Jones & Lamson Machine Company, among others. The Sheffield Precisionaire, already highly publicized and by now familiar to most tool engineers, is shown at right.



At left, the Fish-Schurman Optical Contour Comparator, used to quickly and accurately examine and compare screw threads, gears, dies and parts of instruments. It can also be used, with an attachment, to inspect opaque objects, as fine jewels and small assemblies. The standard model has 25 to 1 amplification and 50 to 1 systems available. The enlarged image is clearly shown on a neat glass screen 9 x 14 inches. Exclusive selling rights have been acquired by the Sheffield Corporation, Dayton, Ohio.

Below, the Sheffield Precisionaire, here shown set up for simultaneously gaging bore diameters of automobile cylinder blocks at 32 points for "Go" and "No Go" measurement is to .0001".

ive work. When it comes to questions of upgrading employees, quality data should be considered and the inspection department should be in a position to supply this data.

In addition, there is the need for reporting quality data to the Tool, Engineering, Planning and other divisions of the business. In the last analysis there is no individual who holds a more key position than the inspector. He is in a position to see the tools, gages and special equipment in production and evaluate the results of their use in terms of the quality obtained. He is the one who has the job of interpreting the quality specification to the shop and then verifying this as the product is produced. He has the opportunity of comparing the quality obtained against the quality desired. The inspector observes the shortcomings of the shop as well as the lack of realism on the part of the engineering department in specifying that which can be produced. It is up to him to report these discrepancies as well as insist that the shop and engineering bring into their operations a greater degree of honesty in their efforts to produce as well as specify the factor of quality.

From the standpoint of the planning department, it is essential that inspection keep that group posted as to points where greatest scrap losses are encountered. Not only will this permit greater accuracy in ordering but will also ensure delivery of a sufficient quantity at the time required.

IV. The Function of Education and Training

The last major function of inspection lies in the area of education and training. It involves the countless procedures which are used for training inspectors so that there will be greater uniformity in interpreting and measuring the quality performance of the shop. These procedures may range from teaching the novice how to read a blueprint or a pair of "mics" to the establishment of quality incentives. The training may take the form of showing, through exhibits and display trucks, the product produced and its various components. Quality trophies may be awarded to departments which have outstanding quality records for specified periods or one may make effective use of the suggestion system. In each instance, the procedure is designed to direct the attention and interest of *employees* to the problem of quality.

The Role of Management

In its broad aspects, training and education should involve procedures which will instill quality mindedness throughout the *whole* organization. We would all agree that industry, in general, strives constantly to produce high quality product at low cost. We would agree that the responsibility for quality is not something which can be conveniently lodged in the hands of one department and made their exclusive property. Quality is the job of everyone.

However, we should point out that Management has a primary role to play. If Management is lukewarm in its support of the quality concept, the line organization will reflect this attitude. If Management takes a vacillating position in regard to their quality program, the shop will exhibit a similar attitude. If Management is *sincere* in its desire for quality production there will be no move to eliminate or de-emphasize a sound quality control program.

Today Management is facing problems of increasing costs and competition which are as serious as the problems of war production. Quality control is a Management tool which is permitting scores of industries to retain their competitive position in a difficult period of our history. It is to their advantage that inspection and quality control work receives unqualified backing.

At left, below, is shown the Federal Indication Micrometer, previously mentioned, and at right, a ball race tester by Physicists Research Company. The latter concern has been prominent in the development of surface contour comparators, and the P-R "Profilometer"—as it is known by trade name—is widely used throughout industry.

At right, Ball Race Tester, by Physicists Research Company, Ann Arbor, Mich., permits production measurement of waviness on ball and roller bearing races. Essentially a production instrument for use on race grinding and finishing departments, operation consists merely of slipping the race on a rotating spindle, holding the converter against the raceway and noting the meter readings. A speaker and oscilloscope provide further surface analysis.

The Indicating Micrometer, by Federal Products Corp'n, Providence, R. I. This "mike" measures and compares visually and eliminates the chance for human error due to variations in pressure.

In conclusion, the quality function assumes the task of interpreting, controlling and verifying quality through measurement and/or comparison with engineering specifications. In the performance of this task, inspection procedures must be developed which will provide protection, maintain product control, portray quality performance, and provide education and training which will develop quality mindedness.

A New Approach to Statistical Quality Control

By Joseph Manuele

A considerable amount of literature has accumulated in the last few years on the subject of statistical quality control. This has had the effect of channelling thought into two very opposite directions. To those people who have been somewhat familiar with the subject of statistical quality control methods, the literature has brought examples of new applications and further proof of its value. To those people who have not had any experience with the use of statistics, the literature has meant more confusion and has even discouraged some would-be adherents, because of the difficulty, or lack of information on, how to start a quality control program.

Frankly, to cover all operations in a plant with control charts is not economically justifiable; neither is personnel available for doing this work on such a tremendous scale. However, statistical methods are definitely valuable, especially in those cases where losses, due to rejections of parts, are high. The question is: "What is a good quality control program possessing possibilities for wide application, and how can such a program be started in the average plant?"

Assuming that some inspection is performed on the product after it is processed, the first step is to acquire some information on: (1) Which parts, or items, are of a satisfactory quality level, (2) Which items are of such a low quality level as to result in rejections, and (3) What is the relative amount of rejections of each product?

Joseph Manuele **started work at 16, taking high school subjects in spare time. Then, leaving a $75 a week job, entered Massachusetts Inst. of Technology, from which he was graduated, in '25, with degree B.S. in Electrical Eng'g. He joined Westinghouse that year as inspector of railway equipment, then, gaining experience inspecting radio apparatus, power induction regulators, network protectors and switchboards, was assigned—1930—to the H.Q. Inspection office. He was promoted to his present position, Director of Quality Control, in 1940.**

If this information is not readily available, it must be accumulated. An economical inspection program for accumulating this information is the use of a simple sampling plan for sampling *all lots* of items processed.

The sampling plan should be designed so that ordinary shop inspectors can use it. It is well to recognize, however, that any sampling plan involves certain risks, and such risks should be defined in the plan. The plan should be flexible

Again diverting from dimensional control, we have a ductility testing machine, by Steel City Testing Laboratory, shown at left below. Quality control has many ramifications, as exemplified by this "gage" and the Thrustorq, by Hagan Corporation, for measuring the impulse thrust of internal combustion engines, shown at right.

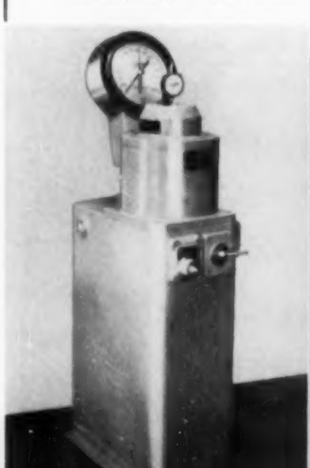
Somewhat novel is the Micro Screw Jack (page 29) by the Engineers' Forging Company, and the hardness tester (built like a pair of pliers for convenience in handling) by R. A. Webster, shown at right. And, on page 31, the Model T-133 Combination Propellor Hub and Regulator Test Rig, by Hydraulic Machinery, Inc., designed to check the hydraulic functions of variable pitch propellors.

In addition, the tool checks for internal and external oil leaks, general operation and rate (time) of pitch change. It can also be used as an assembly stand.

On page 33 is shown a portable thread gage, by the Bryant Chucking Grinder Company. This gage is collapsible, by virtue of which it can be quickly inserted and removed, besides which this feature puts it into the comparator class of gages.

Gages run the gamut from the near microscopic to the colossal, and the gear measuring wires shown on page 34, by the Van Keuren Company, are definitely in the pygmy class. Yet, they are "little giants" as far as their value to the control of quality is concerned. The gages shown are of Carboloy, and the company also makes wires for thread checking, among other precision products.

Ductility Testing Machines, by Steel City Testing Laboratory, 8843 Livernois Ave., Detroit. The Model PA-2 has capacity of 15,000 lbs. for stock up to 1.8" thick, and the Model PA-3 has capacity of 30,000 lbs. for stock up to ½" thick.



The Thrustorq, by Hagan Corporation, Pittsburgh, is a force measuring instrument designed for engine testing. Extremely sensitive, it instantaneously and accurately records the force of engine explosions operating in bursts of 50 cycles per second.

enough to separate lots according to the various levels of quality desired. It might be necessary to control one line of product at a quality level where defects will not be more than one-half per cent. In the case of other items, as high as 5 per cent defects might be allowed. Regardless of the level of quality which has been chosen, the plan must discriminate between good lots and bad lots. Such a sampling plan is illustrated in Table I for a level of quality which permits one per cent defectives to be accepted.

Specific and detailed instructions for the use of the tables should accompany them, so that the inspector might have the instructions available for review at any time. Such

TABLE I

SAMPLING TABLE A-2. 1% DEFECTIVE ALLOWABLE.

1. Lot Size	2. Sample Size	3. No. Defective Allowed in Sample	4. Risk of Accepting a Lot 5% Defective
200- 300	115	1	.13
301- 500	170	2	.11
501- 1000	220	3	.10
1001- 2000	230	3	.09
2001- 3000	240	3	.08
3001- 4000	290	4	.05
4001- 5000	300	4	.05
5001- 7000	345	5	.05
7001- 10000	395	6	.04
10001- 20000	460	7	.03
20001- 50000	540	8	.02
50001-100000	640	9	.01

The average quality of material accepted with this plan is better than 1% defective. The risk of accepting an individual lot as much as 5% defective is given in column 4.

TABLE II

SAMPLING TABLE B-2. 1% DEFECTIVE ALLOWABLE.

1. Lot Size	2. Sample Size	3. No. Defective Allowed in Sample	4. Risk of Accepting a Lot 5% Defective
200- 300	70	1	.13
301- 500	80	1	.09
501- 1000	87	1	.07
1001- 2000	95	1	.05
2001- 3000	125	2	.05
3001- 4000	132	2	.04
4001- 5000	140	2	.03
5001- 7000	148	2	.02
7001- 10000	180	3	.02
10001- 20000	190	3	.01
20001- 50000	200	3	.01
50001-100000	210	3	.007

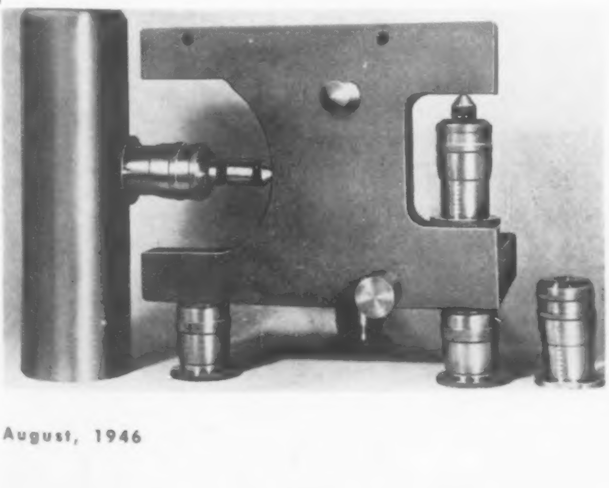
The average quality of material accepted with this plan is better than 1% defective. The risk of accepting an individual lot as much as 5% defective is given in column 4.

At right, on the same page, is shown a set of standard reversible gage sets, by the Size Control Div'n of the American Machine and Gage Company. As previously implied, the reversing feature extends life and accuracy —or, to go even farther, one could use one end of the insert plugs for general inspection while saving the other end for reference.

On page 35 (at left) is shown a Sapphire gage, by the Sapphire Products Division of the Elgin National Watch Co. Elgin has applied sapphire to a wide number of uses in precision measuring instruments and—of considerable interest—has set its plug gages in flexible handles for easy entry into bores. At right, same page, is shown one of a set of direct reading taper leaf gages, by the Moore Special Tool Company.

As previously stated, but a few typical examples of gages could be shown in this "exposition," which may be termed a sequel to "Gages and Inspection Systems—an Exposition" in the September 1945 issue, *The Tool Engineer*. As for the Symposium as a whole, the several guest contributors—Messrs. Marks, Davis, Manuele and Miller—are to be commended for their comprehensive analysis and treatment of the subject of Quality Control.

For the reader, there is a wealth of literature on this subject, and all of it is avidly read. Several of the gage makers—as Pratt & Whitney, the Sheffield Corporation, Federal Products Corporation, Johnson Gage Company, Ford Motor Company, DoALL and others have published outstanding treatises on gages and gaging. In some cases, demand for copies has been so great that supplies are exhausted. In addition, bulletins and advertisements are constantly acquainting industry with new developments, all of them essential to the Control of Quality.



The Micro Screw Jack and Micro Height Gage, by the Engineers' Forging Co., 308 Blvd. Bldg., Detroit. Suitable alike for direct measuring and as a micrometer levelling jack, this gage has many uses.

Two new Hardness Gages, by R. A. Webster, 422 Twentieth St., Santa Monica, Calif., are uniquely designed for convenience and provided with dial indicators with reading ranges from 0 to 20.

instructions, Fig. 1, should be simple and complete. They must be readily understood by people without statistical background, and the results of the sampling operation should be recorded on a regular report in a uniform manner, so that they might be reviewed by a trained statistician daily. A convenient form of report is shown in Fig. 2.

This program is essentially a single sampling plan. Lots are either accepted or rejected, depending upon the number of defective parts in the sample. Rejected lots are detailed or inspected 100 per cent, and the results of this detail inspection are recorded also on the report under "Results of Detailing." The per cent defective is also calculated for each "detailed lot."

The notes on the back of the report describe the type of defects found. If these defects are recurrent or serious, steps are taken to eliminate them by modification or improvement in tools or process. Every day a trained statistician reviews all reports on which postings have been made during the day. This review is made for the purpose of: (1) Reducing the sample size in the interest of more economical inspec-

SAMPLING TABLE A-2

When parts are received, or are produced, in quantities it is always desirable to determine the quality of a lot of such parts. This can be done by inspecting the parts 100%, which is relatively a slow and expensive operation, or by scientific sampling of the parts.

The table has been calculated to pass lots which have not more than 1% defective "in the long run." It also shows the degree of risk of accepting individual lots containing more than 1% defective.

As an example, let us suppose that we have a lot of 1325 parts of a particular drawing and item. Let us assume that we do not want more than 1% defective parts, then we refer to "Sampling Table A-2, 1% Defective Allowable."

Since we have 1325 parts, reference to the table will show that we must take a sample of 230 parts. We proceed to inspect these 230 parts very carefully and if we find *three defective parts or less* we will accept the entire lot. If we find four or more defective parts, we reject the lot, and either detail the lot, or return it to the supplier.

This procedure assures us that *in the long run* the number of defective parts in accepted lots will not exceed 1%. However, we note in the column headed, "Risk of Accepting Lots 3% Defective," there is the figure .09 opposite sample size 230. This means that we might accept a *single lot* which contains as much as 3% *defective* parts about 9% of the time or about one time in eleven.

Use of this table will reduce inspection costs and assure better quality of parts by putting the inspection where it belongs, on lots containing a high percentage of defective parts.

In order to make the most efficient use of this table, the results of inspection should be recorded on record card, Fig. 2.

FIG. 1. Directions for using Sampling Table A-2.

SAMPLING TABLE B-2 — REDUCED SAMPLING

Sampling Plan "B" is a supplement to Sampling Plan "A."

The recommended procedure for using Sampling Plan "B" is as follows:

If ten consecutive lots of an item pass Plan "A," change to Plan "B." If an item which is on Plan "B" fails to pass, even for a single lot, go back to Plan "A."

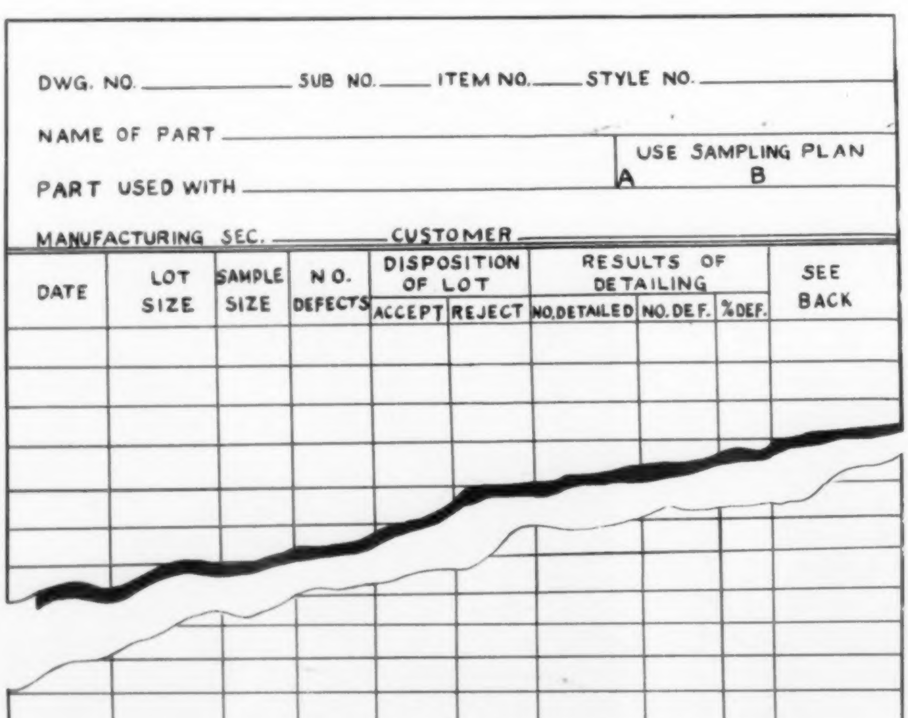
In Plan "B" the amount of inspection required is less than half of that required by Plan "A." The average quality of material accepted by Plan "B" is the same as that accepted by Plan "A," *in the long run.* However, the risk of accepting a single lot of inferior quality is greater with Plan "B" than with Plan "A." On the other hand, Plan "B" is not used until there is some assurance of uniform high quality; namely, ten consecutive lots of a particular item have been passed by Plan "A."

As an example of the use of Plan "B," suppose that ten consecutive lots of a certain item have passed Plan "A." Suppose, further that we have a lot of 1325 parts. Let us assume that our allowable fraction defective for this item is 1%. We then refer to "Sampling Table B-2, 1% Defective Allowable."

Since we have 1325 parts, reference to the table will show that we must take a sample of 95 parts. We proceed to inspect these 95 parts very carefully. If we find one *defective part* or less we will accept the entire lot. If we find two or more defective parts we reject the lot, and either detail or return it to the supplier. Moreover, *for subsequent lots of this part, we go back to Plan "A" until ten consecutive lots again pass inspection.* However, as long as lots pass Sampling Table B-2, we continue to inspect in accordance with this plan.

This procedure assures us that *in the long run* the number of defective parts in accepted lots will not exceed 1%. However, we note in the column headed, "Risk of Accepting a Lot 5% Defective," there is the figure .05 opposite sample size 95. This means that we might accept a *single lot* which contains as much as 5% *defective* parts about 5% of the time or about one time in twenty.

FIG. 3. Directions for using Sampling Table B-2.


DWG. NO. ______ SUB NO. ______ ITEM NO. ______ STYLE NO. ______

NAME OF PART ______

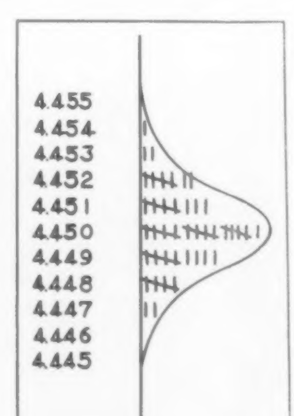
PART USED WITH ______ USE SAMPLING PLAN A B

MANUFACTURING SEC. ______ CUSTOMER ______

DATE	LOT SIZE	SAMPLE SIZE	NO. DEFECTS	DISPOSITION OF LOT		RESULTS OF DETAILING			SEE BACK
				ACCEPT	REJECT	NO. DETAILED	NO. DEF.	% DEF.	

FIG. 2. Record of results of sampling when using Table A-2 or Table B-2. Note that the results of detailing rejected lots are also recorded on this form.

FIG. 4, below. A simple frequency distribution to show the results of an initial study of a process.



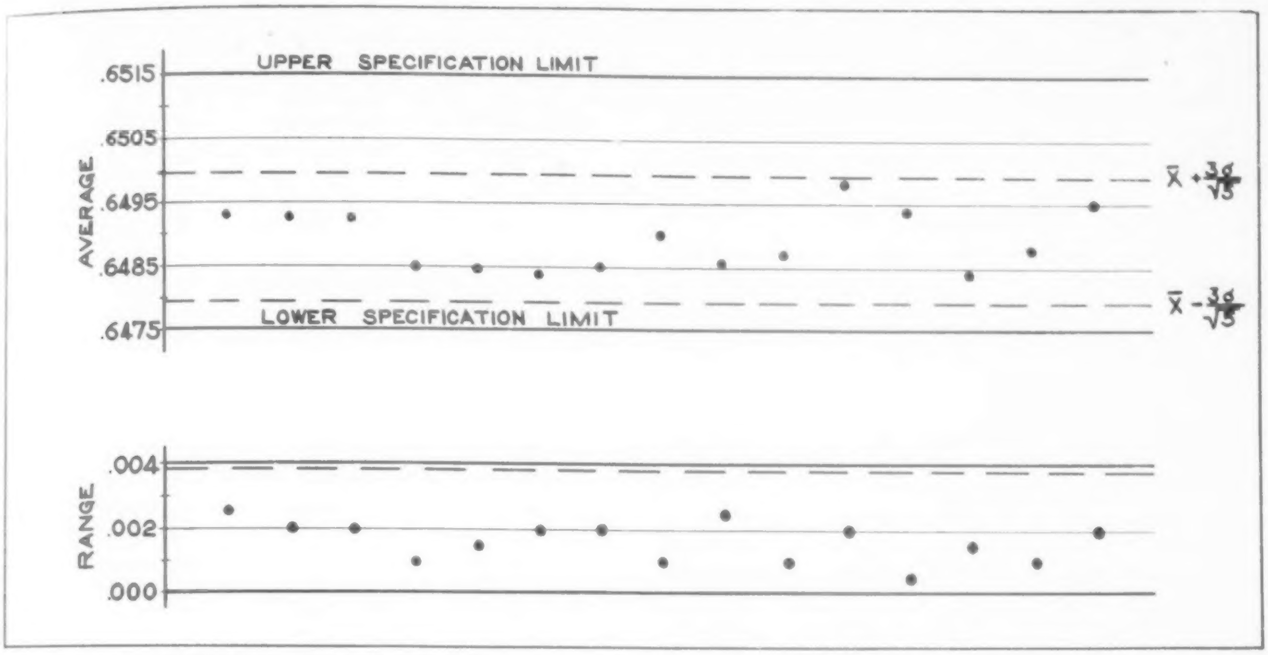


FIG. 5. Typical control chart for X and R.

tion; (2) Institution of proper control methods at the point where defects are created, so that the creation of defectives will be eliminated.

When ten or more consecutive lots have been accepted on the basis of sampling, in accordance with Plan "A," it is safe to reduce the sample size to that shown in Plan "B." See Table II. After Plan "B" has been instituted, it shall continue in operation as long as lots are being accepted. If a lot, inspected in accordance with Sampling Plan "B," is rejected, Sampling Plan "B" is discontinued and the sampling procedure reverts back to Plan "A." See Fig. 3.

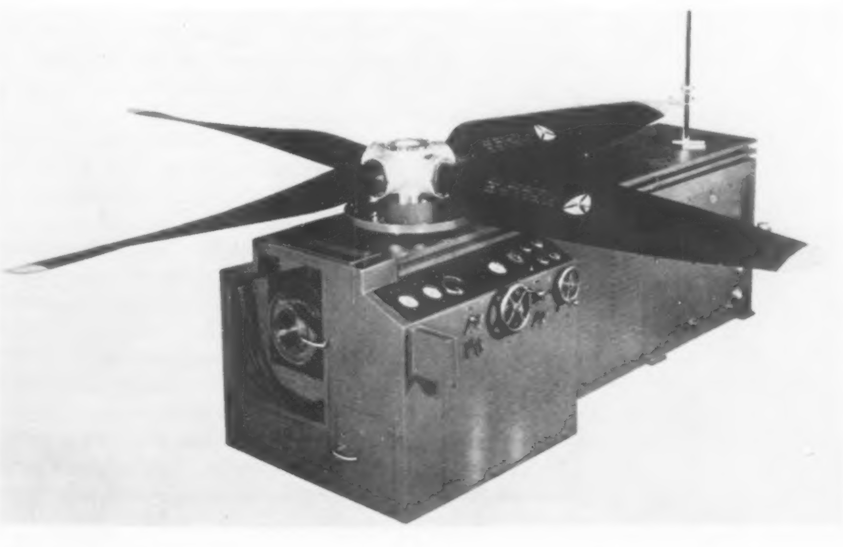
When lots show defects to be unacceptably high, it is necessary that controls be initiated to improve the quality. These controls may be a control chart placed at the operation. Patrol inspection, which is a simplified form of the control chart method, may be used in some cases. It is very important, however, that whatever method is adopted be adhered to rigorously. If a control chart method is used, it is necessary that tools, and/or methods or processes be changed until the chart shows that the quality has been brought into proper control.

A quick method of determining what might be the assignable cause is to chart the quality characteristic by means of simple check marks, as shown in Fig. 4. We refer to this as a frequency distribution. This will quickly show (1) Whether the average is wrong. This can be corrected by adjusting the machine or process in order to shift the average in the proper direction and by the proper amount; (2) Whether the band spread is too wide, sigma is too large. This shows too wide variation from part to part. This might be due to dull cutting tools, loose bearings or spindles in the machine, or poor skill on the part of the operator, in the case of bench operations.

If a frequency distribution shows quality to be satisfactory, then a control chart can be constructed in the usual manner.

Charts Aid Quality Control

The best type of control chart for this purpose is the conventional X and R Chart. This chart shows the center tendency, or average quality, as produced by the process, from time to time. It also shows the variability in the quality of the product from time to time, as indicated by the Range, R. By adjusting the process or tools to bring



A "Gage" on a large scale is the Model T-133 Combination Propellor Hub and Regulator Test Rig, by Hydraulic Machinery, Inc., 12825 Ford Road, Dearborn, Mich. Designed to check hydraulic pressures, general operation and rate of pitch change, the propellor blades can be rotated, while under pressure, for the full 360° for checking propellor track.

about the desired changes in the average, X, and the Range, R, it is relatively simple to achieve, and keep, control so the quality will be at the desired level.

A typical control chart for averages, X, and Ranges, R, is shown in Fig. 5. This particular chart is for samples of five. Samples of four are used in some cases. Patrol inspection is essentially the control chart technique, except that the sample size is one, and the results of inspection are recorded on a tag, or not recorded at all in some cases.

The problem still remains of how large a program should be undertaken during the initiatory stages of the inauguration of a quality control program, and during the period that inspectors are trained in these methods. It is best that the program be started in a single department of the plant, and that this department is one in which the line foreman is at least sympathetic to statistical methods. It is best to explain the plan to the foreman and the inspectors.

Training Time Recommended

It is important that, once the plan is inaugurated, it be operated for at least a sufficiently long period to allow time for it to prove itself. Many a good quality control plan has been dropped prematurely because not sufficient time was allowed for the proper training of personnel, or the "correction of bugs." The length of this probationary period will vary from a few days to a few weeks. However, results should become apparent at the end of three or four weeks.

It is well to realize, at the outset, that no quality control program will improve quality, increase production, or lower unit costs. The quality control program will point out what defects are created by conditions which need correction. Generally, it cannot recommend or suggest the necessary corrections. These have to be made by the line organization; therefore, it is well to realize that defects are created by the process and that the process must be corrected by the line organization. The inspector, in his administration of the quality control program, merely assists the line organization in the detection of that part of the process which is out of control. Without the whole-hearted cooperation of the line organization, no quality control program can be expected to succeed, for it must be realized at all times, that *quality must be built into a product; it cannot be inspected into it.*

Dimensional Control

By Paul V. Miller

During recent years the system of manufacturing interchangeable parts has spread to almost every industry in this country, and wherever any degree of precision is to be maintained we find that control of all essential dimensions is maintained through the use of gages for the inspection of the product. Even in industries where free fits are generally employed, it is quite common to find that a complement of gages is maintained for the periodic inspection of dies, molds fixtures and other tools, thus insuring the size control required for ready assembly. Also, many of our basic industries maintain a high degree of uniformity in their manufactured product through the use of gages of one type or another.

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During the past decade and particularly through the war years, many new developments and applications have been made in the field of gage design and many improvements in the construction of existing types have been effected to give the improved economy desired for volume production which is necessary if we are to meet the ever increasing costs which are facing us today. One of the many developments giving improved gage performance has been the use of sintered carbides for many applications, particularly such fixed gages as plain plug and ring and thread plug gages. By the judicious use of this material, gage life has been increased many times at only a slight increase in original cost and at a much lower ultimate cost.

In the field of amplifying and indicating gages, there have been many new devices put on the market incorporating newly developed or improved electro magnetic and electronic circuits as well as those utilizing the principle of pneumatic gaging. Of equal importance has been the standardization of improved design for many solid and adjustable types of gages through the efforts of the American Gage Design Committee. This work was originally undertaken, about twenty years ago, by a group of interested gage users and manufacturers under the leadership of the Ordnance Department and has resulted in the standardization of dimensions for many types of gages and gage blanks. These standards have been generally accepted by manufacturers and users of gages in all branches of industry and offer the engineer a gage of proven design and construction.

Selection of Design and Use

Proper quality or dimensional control will be obtained by the selection or design and use of a gage or gages which will properly check the dimension or dimensions involved to the prescribed sizes and tolerances but if this operation is to be performed with the greatest economy, then consideration must be given, not only to the cost of the gages but to the cost of the inspection time and labor as well. Too often a lack of study and care in the selection of the type of gage to be used may result in the consumption of an excessive amount of time for the inspection operation and the resultant cost may be high.

In considering the types and styles of gages that are available for product inspection, a very important consideration is the probable accuracy to which the gage can be manufactured and the degree of precision which may be maintained through its use as an inspection device. For, without accurate dimensional control, neither quality nor economy can be attained. Much of the progress made during recent years in improving the quality and accuracy of our gages and our product has been attained through the use of a uniform and accurate standard of measurement. The foundation of our present inspection system as well as the accuracy and uniformity of our gages is dependent to a great extent upon our development and use of the gage block system of measurement. Pioneered many years ago, this system has been almost universally adopted in the metal working industries in the making of all fine measurements either by direct application or through comparison by using an amplifying gage. To the almost universal adoption of this basic means of measurement and to the high degree of accuracy and uniformity maintained in the manufacturing of these gage blocks can be credited the nation-wide interchangeability so commonly obtained today.

In the broader sense, a gage may be defined as a tool used to determine the dimensional quality or qualities of a particular part and in discussing economic control, one of the primary considerations must be the style or type of gage which will indicate this quality with the greatest rapidity and accuracy. To assure proper consideration and selection of the most suitable gage when studying the requirements of an inspection operation, a general classification might be made. There are many specific types and designs of gages but they can be generally classified as measuring gages, fixed gages, indicating and comparator gages, functional gages and continuous and automatic gages.

"Tools of Today" for Today

Conventional types of measuring gages, although quite commonly used for inspection some years ago, are not used to any great extent today in product inspection except in the checking of small lots and short runs. However, micrometers, vernier calipers, gear tooth verniers and allied tools are widely used in making the measurements necessary when setting up for the production run and these tools are frequently very useful as an adjunct to the other gages in determining size, parallelism, and roundness. Quite frequently gages of the indicating or comparator type, equipped with graduated dials, are used for making measurements within their range for particularly close tolerances or for the classification of parts to be used in selective assembly where the allowance must be held to a very close limit. This procedure is often economical when difficulty is encountered in producing parts to the desired uniformity.

Of the gages currently used for inspection work, a large majority are of the fixed type which may be either solid, or adjustable set and sealed to size. This classification covers both plain and threaded plug, ring and snap gages, length and contour gages of the conventional type.

For inspection of product both at the machine and in final inspection, plain plug gages of several different constructions may be used. In the smaller sizes perhaps the double end gage is the more popular although for holes of not too great a depth the progressive type plug gage is widely used and its use probably results in some saving of time. For the larger diameters and for bores of greater depth, it is frequently desirable to use separate single end gages to avoid excessive weight.

Piloted Gages Recommended

In the inspection of holes where the tolerances are small and every effort must be made to produce and retain the best possible finish, it is often desirable to use a plug gage with a pilot to ensure quick and convenient entry of the gage and to avoid any scratching or marring of the finished surface. Several different types of pilots have been developed, one of which utilizes a narrow land about one-sixteenth to one-eighth of an inch in front of the body of the gage, a second is made with a spherical segment ground in the front or entering end of the gage member and a third employs a ring of hardened steel balls in an annular retainer encircling the front end of the gage.

These devices all promote easy and convenient entry of the plug gage if the hole is larger than the gage size and are very helpful in increasing inspection efficiency if the size is close or if the product is bulky or difficult to handle. They have proven particularly useful where unskilled help has to be used for certain routine inspection of machined parts. Another very important factor from the economic standpoint is the material used in the manufacturing of the plain plug gage. For a majority of cases, hardened tool steel is entirely suitable, but where production schedules call for a large quantity, or where close tolerances practically eliminate the advisability of using any of the product tolerances for a wear allowance, it will often be found advisable to use a material which will give less wear and longer gage life.

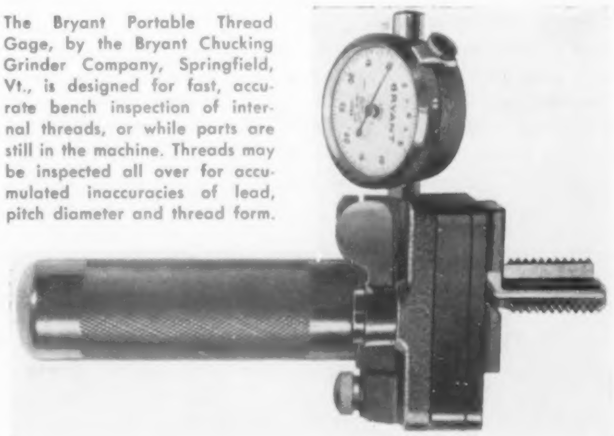
Perhaps the most widely used method of increasing the gage life has been to apply hard chrome plate to the gage before finish grinding and lapping. This procedure will result in an improvement in gage life of from three to five times, but if it seems desirable to secure greater durability than this, it will probably be economical to manufacture the gage from some of the harder materials such as tungsten carbide, norbide or synthetic sapphire as the use of these materials will frequently increase the ultimate life of the gage from fifty to one hundred times that of a steel gage.

For size control in the inspection of shafts and external diameters, where the quantities and tolerances do not warrant the use of elaborate or expensive inspection equipment, plain ring gages and snap gages of both the solid and adjustable type will be found very satisfactory. These gages may be secured, manufactured from hardened toolsteel or of any of the harder materials just mentioned in which case a correspondingly longer gage life will be assured. Frequently, a snap gage will be found adequate for the final inspection operation but, in some cases, it may be found desirable to use a plain cylindrical ring gage or the "go" gage and a snap gage for the "No Go" gage if there is a possibility of encountering any difficulty with an out-of-round condition.

Power Gaging for Economy

For the inspection of threaded product the use of the thread plug gage for internal threads is almost universal while for external threads we may employ the thread ring gage, the thread snap gage or the projection type comparator. For the inspection of internal threads a double end plug thread gage of proper size and pitch will maintain very satisfactory control. The "go" plug gage of full form thread and suitable length will accept work which is large enough in diameter to permit easy assembly and the "No Go" gage of relatively short length and truncated major diameter will accept only work which is not oversize on the pitch diameter.

For the inspection of external threads equally good results will be obtained by the use of limit ring thread gages or a thread snap gage. For a complete inspection of the thread elements including the pitch, thread angle and diameters, a projection type comparator will be found to be very useful but this may not be required for other than an occasional check unless it is found necessary to maintain all thread elements to close tolerances.



The Bryant Portable Thread Gage, by the Bryant Chucking Grinder Company, Springfield, Vt., is designed for fast, accurate bench inspection of internal threads, or while parts are still in the machine. Threads may be inspected all over for accumulated inaccuracies of lead, pitch diameter and thread form.

"Packaged" Measuring Wires, by the Van Keuren Co., 176 Waltham St., Watertown, Mass. Designed for simplified gear and thread measurement, these Carboloy gages are accurate to within 25 millionths of an inch.

When threaded parts are being manufactured in large quantities to close tolerances, it often becomes necessary to maintain 100 per cent inspection to eliminate any possibility of faulty product and as the insertion of the "go" plug thread gage is time consuming to say the least, some economy may be realized by power gaging. Usually, a bench type tapping head is employed as this offers a sensitive means of reversal for the withdrawal of the gage after proper depth has been gaged. This method is very likely to result in increased gage wear which can be overcome by using a plug thread gage made of tungsten carbide which will withstand the heavier usage with excellent results.

Several adjustable length gages of slightly different construction are available, and these gages will be found very satisfactory for the checking of the overall length of shafts, or the dimension over parallel pads, bosses, and plane surfaces. For the inspection of contours, shoulders, and irregular shapes, a special design is necessary, although these gages frequently follow a similar pattern. A flat gage from $\frac{1}{8}$" to $\frac{1}{4}$" thick, with graduated lines or ground steps, is usually suitable for this class of work, although if it is necessary to work to close tolerances on a particular dimension a fixture gage utilizing a flush contact pin, or an indicator, may be required.

Adjustable and Fixed Gages

Indicating and comparator gages of both the external and internal variety are very generally used today in the inspection of product which is manufactured to close tolerances, particularly where the quantities are sufficient to warrant the necessary investment. There are a variety of these gages available with mechanisms that have been developed on various principles, such as mechanical, optical, electro magnetic and electronic amplification, and all of them can be relied on to give excellent comparison and measurement within their range.

These gages are arranged to give direct dial readings, or to indicate by tolerance hands or tolerance lights whether or not the part is within the prescribed limits. These gages may be divided into two classifications as they are usually manufactured either as an adjustable or a fixed gage. The adjustable type may be arranged to accommodate the inspection of any diameter or length within its range which

Standard Reversible Gage Sets, in cabinets, by the Size Control Div'n of the American Machine and Gage Co., 4636 W. Fulton St., Chicago. In addition to the plug gages shown, thread gages are available in Size Control reversible type, made up in partial or complete thread series.

usually covers several inches, while the fixed type has been made for the checking of a certain specific dimension. This latter type is frequently used in arranging a combination gage, which will be found very economical for use in the final inspection of a part having several dimensions which may be checked simultaneously.

It is often constructed utilizing tolerance lights which may indicate the condition of each particular dimension, but may use only one set of lights to accept the part if all dimensions are within the limits, and reject it if one or more are not within these limits. The measuring type of comparator gage offers one advantage over the limit type in that it is always possible to determine any out of round, out of parallel, or taper condition, and measure the degree of error although the dimension may still be within the prescribed tolerance. This type of instrument is also very useful when it may become necessary to grade the product for use to avoid selection at the time of assembly.

A Trend to Air Gages

Another comparator type gage which has been developed during recent years, and has proven very satisfactory, is the air gage. This gage is so calibrated that in metering the amount of air which will escape through a given orifice, the resulting pressure or velocity gives an accurate indication of the diameter or size of the work. These gages are particularly useful on internal diameters and deep holes where it might be very difficult to make reliable measurements by any other means. The gage head is primarily a plain "Go" plug member, with a proper recess and orifice, connected through a suitable handle and flexible tube to the source. The flow of air through the orifice, when the gage head is inserted, will give a correct indication of the size of the hole.

A functional gage is basically a "Go" gage which will determine the correctness of size and the relationship of two or more surfaces or diameters. Either this gage must be used in conjunction with a suitable complement of "No Go" gages or it should be equipped with progressive or indicating type gage members. A distinction should be made between a functional gage and a combination gage as the latter is used only for the measurement of more than one diameter simultaneously, while the former will also indicate the relationship between certain particular surfaces.

Many gages in this category are considered special and must be designed and built to accommodate a particular part. However, when the work is of a flat section with the surfaces to be inspected parallel to a common axis, the

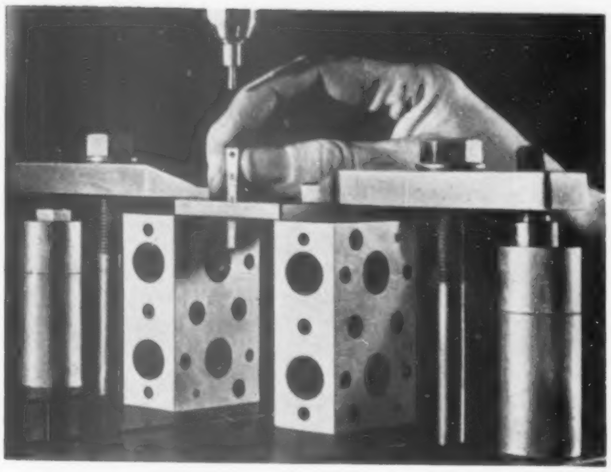
Sapphire gages, by the Elgin National Watch Company, Elgin, Ill., set in Elgin Flexible plug handles. Because the operator can approach the hole to be checked to within 20° of the axis, and still obtain perfect alignment, the gaging member is relieved of handling abuse and operator fatigue is reduced.

projection machine offers one of the best devices for the measuring of all of the elements. With this machine an optically magnified image of the part may be compared with a suitably enlarged scale drawing and any variations from the chart may be accurately measured or closely estimated.

In certain industries, where a very large number of identical parts are manufactured to close tolerances, it has been found economical to develop semi-automatic and automatic gaging machines for the final inspection operation. These machines, usually, are arranged to measure the product and sort the parts for size within very close tolerance zones to permit selection of the proper size to fit a corresponding component at assembly. Gaging machines of this type have been used very successfully in the ball and roller bearing industries where the assembly must be made with exactly the right allowance to insure proper functioning of the bearing.

Another type of gage which is automatic in its operation is the continuous gage developed for the accurate measurement of strips and sheets during the rolling process. Until recently the hand micrometer was the only available means of measuring the thickness of a strip steel and this could only be done by slowing down the mill to a speed of one to two hundred feet per minute. With this gage continuous measurements of a very high degree of accuracy are being made at speeds of from fifteen hundred to three thousand feet per minute. This method has not only impoved the accuracy and quality of the product but has greatly facilitated production by permitting higher continuous operating speeds.

In considering current production problems many industries with high production schedules will find it economical to utilize the more elaborate inspection devices which will give the ultimate in accurate dimensional control with the



The Moore Direct Reading Leaf Taper Gage, by the Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn. Designed to measure to the exact size of trial cuts, during boring or grinding, 36 individual leafs, graduated in thousandths, permit a direct reading from .095" to 1.005" without reference to any other gage.

minimum in cost per unit whereas other manufacturers with somewhat limited markets and consequently lower production schedules will realize greater economy from the use of the more elementary types of gages with the minimum of investment even though there be some additional cost in inspection time. The problem which faces the engineer, therefore, is, what method of inspection or what type of inspection device will permit the greatest economy while giving suitable control of quality in the product.

In selecting or designing inspection equipment to maintain proper dimensional control, the tool engineer will do well to consider the ultimate economy to be gained. It is of primary importance that all pertinent data covering production quantities and duration runs be made available for his consideration and study prior to the selection of the gages or gaging fixtures to be purchased.

Having prepared his budget covering the probable equipment investment and allowable inspection time costs he is then in a position to determine whether multi-stage or single purpose instruments are to be used for the measuring of certain diameters, whether an air gage, an indicating gage or a plain limit plug gage is to be recommended for the inspection of a hole or whether semi-automatic or manual methods should be used for the inspection, selection and classification necessary to obtain a selective fit. In the selection of the elementary types of gages, such as plugs, rings and snaps, a variety of design and material is available for various applications. It is, therefore, necessary to give careful study to the requirements of the job in the selection of suitable type and material.

Easy-to-remove Resinous Coating

Protection for such products as cutting tools, gears, drills and taps against moisture, alkali and acid condition, is afforded by Plastipak, a new resinous coating introduced by Puritan Co., Inc., Rochester, N. Y.

The coating can be applied at room temperature, either by dip or spray, to form a clear, tough, elastic, transparent or colored film. Requiring no special equipment for application or drying, it peels off readily in one continuous strip, providing an efficient protection for products in process, storage, or in transit.

By B. P. Graves

Automatic and Indexing Fixtures*

Ultra - Modern Tools and Methods Essential to Manufacturing Economy

With soaring labor and material costs on the one hand, and a consumer market that—one may assume—will resist commensurate price increases, on the other hand, industry must take steps to balance extremes. For, if wages and materials rise disproportionately in ratio to selling price of finished products, ways must be evolved to produce more goods in a given time interval. In other words, rising manufacturing costs must be balanced with lower unit costs.

There are several ways to attain this objective: (1) by demanding greater output, per operator, without change in methods, machines, fixtures and tools; (2) to re-equip with single purpose, automatic machines; (3) to take advantage of the latest machine tools, accessories and techniques, and (4) to "soup up," using that term, existing equipment with automatic, quick acting fixtures.

B. P. Graves, Director of Design, the Brown & Sharpe Mfg. Co., and a member of Little Rhody Chapter, A.S.T.E., has been previously introduced to our readers. In this article, he shows the savings, in time and costs, to be effected with automatic fixtures.

Under present conditions, the first means suggested could not be applied. For even if labor would agree to greater exertion—a dubitable surmise in itself—there are both human and mechanical barriers to such step-up of production. A man's ability to produce is largely governed by physical endurance and the tools at his disposal. However willing, he can do just so much and no more. And the capacity of a machine is also limited, both by its physical characteristics and the tools used. We therefore discard the first proposition as impractical.

Proposition 2 has practical aspects only if considered in relation to huge quantities of product that would not be seasonally changed or which would permit of amortization of special equipment in a comparatively short time. In view of the fact that the bulk of manufactured goods is being constantly changed and improved, we can also discard this proposition except in isolated cases that would be exceptions to a rule.

Proposition 3 has the advantage that it is not only practical but, in many instances, would spell the difference between profit and loss. Manufacturing economy, today, dictates the use of rugged, ultra-modern machine tools designed to stand up under the speeds and feeds resulting from the use of carbide tools and other developments of this age. And, depending on competition and the limits of financial capacity, such modern equipment should be installed whenever possible.

"Convert" with Fixtures

It may be, hovever, that deliveries are remote, or that existing equipment will meet all reasonable demand for speeds and feeds—that is, that it will compare favorably in potential productive capacity, with the latest developments—but may yet be unequal to the demand. For instance, it may be producing 100 pieces per hour, when the required output is twice that. In such cases, proposition 4 would apply since, by the use of automatic fixtures, its productive capacity would be limited only by the speed of cutters, rate of feed, fixture movement and index and the capacity of the operator to load and unload. And here, good design dictates that every reasonable consideration be given to operator safety and convenience.

Typical of such tooling is an electrically-operator automatic indexing fixture (Fig. 1) for milling teeth on boiler tube cutters that have unequal indexes.

**Adapted from a paper, by the author, at the ASTE New Era Exposition, Cleveland, Ohio.*

FIG. 1. Electrically operated automatic index fixture to mill teeth on boiler tube cutters.

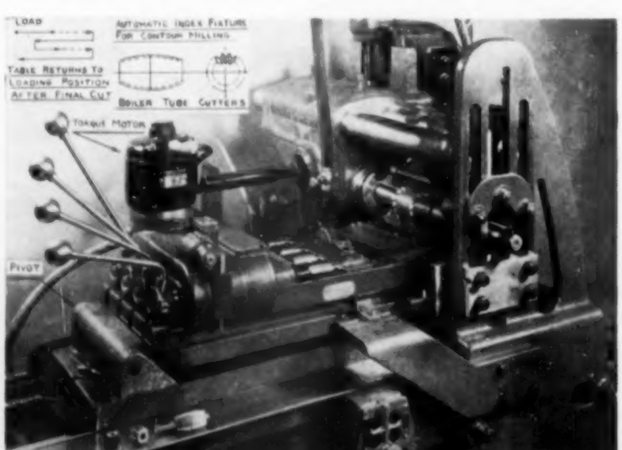
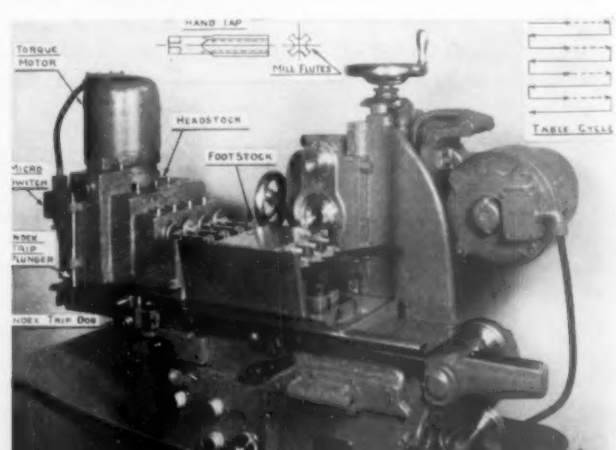


FIG. 2. An electrically operated automatic index fixture for milling flutes in hand taps.



This fixture is bolted to a tilting arrangement which is controlled by two formers. These formers are doweled to stationary parts of the machine, at the front and rear of the table, and can be readily changed for different shapes when necessary.

The torque motor gives a constant pressure through a gear train, from spindle to spindle, while the index plate is on the last spindle so that all backlash is removed when the index pin drops into position. The index pin is removed by a flipper dog which operates on the return cycle after the cutter is out of the work. The index plunger is raised and instantly allowed to fall back again.

The torque motor, in the meantime, has caused the spindles to rotate and this rotation is kept up until the index plunger—which is actuated by a spring—is dropped into the next position. The reason for the selection of electric motor as motive power was because of the small amount of power required, necessary rotary motion, adaptability to irregular indexes, and the convenience of control in conjunction with the machine.

Hand Tap Fluting

An electrically-operated automatic indexing fixture, for milling the flutes in hand taps, is shown in Fig. 2. The torque motor seen on the back of fixture is geared by means of a worm and worm wheel to the rear spindle. The four spindles are connected by spur gearing. An index plate is mounted on the L. H. end of the front spindle and the torque motor exerts a constant pressure through the gearing to the index pin, thereby eliminating any possibility of backlash in the gearing between the spindles.

The index trip dog, mounted on the front of the bed, is a flipper-type dog that raises the index trip plunger—connected to the index pin by gearing—on the return stroke of the table. The momentary raising of the index trip plunger causes the index pin to be withdrawn from the slot in the index plate, and the pressure exerted by the torque motor causes the latter to rotate. The index pin drops back on to the top of the index plate which rotates until the index pin finds the next slot in the plate. After the final cut has been made, a cam on the index plate operates a microswitch, stopping the machine. As in the case of Fig. 1, electrical drive was selected because of the small amount of power required—it furnishes the necessary rotary motion and convenient method of control through electrical devices already part of the machine.

Fig. 3 shows a No. 12 Brown & Sharpe Plain Milling Machine fitted with special equipment for milling the outside form on turbine buckets. Here, we have electrically synchronized the regular table movements with a special motor-driven rotary fixture to produce the required form. The following machine cycle is obtained by pushing the start button:

Machine table advances toward the right at quick traverse rate. Just before entering the cut, the table movement changes to feed rate and continues through the straight cut. At the end of this cut, the table movement stops and the rotary feed starts. Rotary feed continues through the required angle after which the rotary feed stops and the table feed starts. It continues towards the right to the end of the final straight cut.

At this point, the table reverses at quick traverse rate and returns the loading position and stops. At the same time, the rotary fixture reverses at twice the feed rate and returns to its initial position. Since the rotary fixture swings the flat work surface out of the cutter path at the same time that table returns, the cutter does not mark the work during this return movement.

Here, we show a case where electricity, through the use of plugging switches in both the longitudinal and rotary movements, was the best means of controlling a series of related mechanical movements to produce a desired result. Air was used in the rotary fixture backlash arrangement because an air cylinder produced the required force with a long travel and at the same time provided a convenient way of releasing this force.

Air Simplifies Tooling

A standard Brown & Sharpe Plain Milling Machine equipped with an oscillating fixture is shown in Fig. 4. The stock geared motor operates through an eccentric and connecting rod to cause the work to oscillate back and forth through the desired angle. As the work oscillates, the cutter is fed through, giving the results as shown in the upper left-hand sketch. This method eliminates running the cutter through the work several times in order to remove all the stock contained within the 45 degree angle.

In Fig. 5, we show a special automatic air-operated indexing fixture for rough milling bevel gear teeth by a single pass of a gear cutter through each gear tooth space. In this case, air pressure was selected as the operating medium for three reasons: (1) It was the most compact means of obtaining the necessary operating and locking pressure; (2) its straight-line motion was easily adapted to the type of indexing mechanism that we planned to apply, and (3) the customer has air pressure available.

This fixture has a built-in double action air cylinder which operates a ratchet-type indexing mechanism. Air pressure to this cylinder is controlled by a solenoid-type air valve.

FIG. 3. Special equipment, for milling the outside form on turbine blades, fitted to B & S No. 12 Plain Milling Machine.

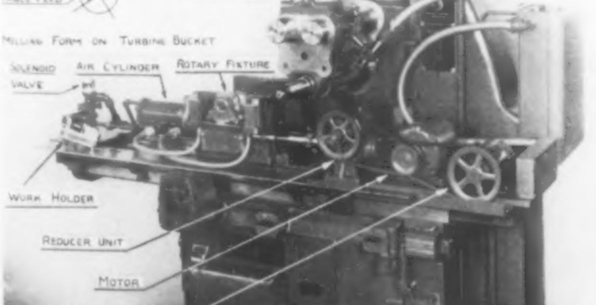


FIG. 4. A B & S Plain Milling Machine equipped with an oscillating fixture.

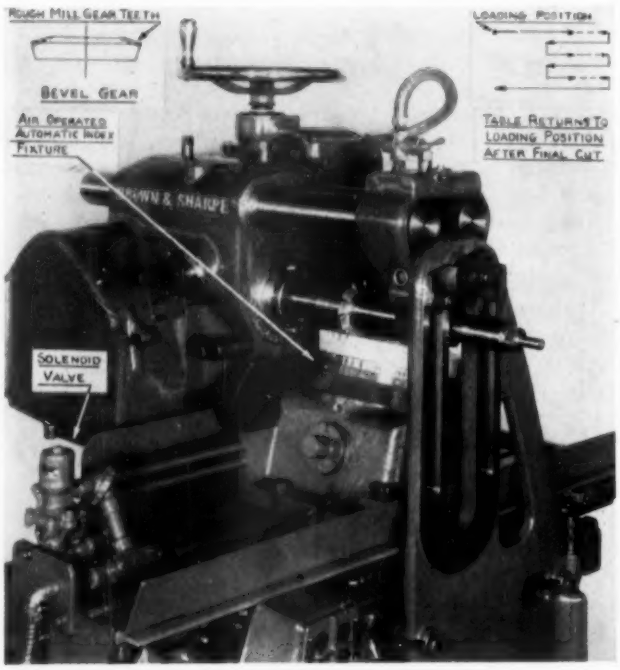


FIG. 5. A special automatic air operated fixture for rough milling bevel gear teeth at a single pass.

Indexing of this fixture, to the next cutting position, is done during the table return movement after the cutter has cleared the work. A special table dog starts the indexing cycle by operating a limit switch mounted on the machine base. During the cutting action, air pressure on one side of the air cylinder forces the index plate to be kept in contact with the index locking pin.

As shown by the diagrammatic sketch in the upper right-hand corner, the machine table starts from the loading position, advances through the cut, reverses and returns to a position far enough from the work to allow the cutter to clear the work and a further movement to allow time for indexing (which is a fraction of a second for most bevel gears). At this position, the table reverses and advances through the next cut. This shorter table travel is automatically continued for the number of cuts required to complete the gear. After the final cut has been made, a switch within the fixture causes the table to return to the loading position.

Individual Index Plates

Air-operated head raising equipment, to remove the cutter from a finished slot, is shown in Fig. 6. The design incorporates an automatic six-spindle, air-operated head and a special air-operated automatic clamping yoke. The chief object in selecting air, in preference to electric power, was the amount of power required to operate the different units and the ease of controlling the cycle.

There are six spindles in this fixture, and each of these spindles has a separate index plate and locking plunger. This construction was necessary to obtain the accuracy required by the customer since, by use of the air, we tie in the movements of these locking plungers with the indexing of the spindles. After making the required number of cuts the machine table will return to the loading position and stop.

There is also the necessity of timing the vertical movement of head with the clamping of the outer brace. All of the units are controlled by solenoid-operated air valves which are tied in with electrical controls of the standard machine.

This attachment, shown in Fig. 7, is designed for work that requires two vertical positions. Various set-ups can be obtained by trip dogs mounted on a vertical post attached to the spindle head. Feeds of ½" to 7⅝" are obtainable through change gears, and there is also a quick traverse rate of 40" per minute. These feeds can be used in conjunction with the table movements in various automatic cycles.

Fig. 8 shows an application of L. H., and R. H. fixtures. As a safety feature, the table stops after completing the cut, thus allowing the operator to load one fixture, while

FIG. 6. Air operated head raising device to facilitate removal of a cutter from a finished slot.

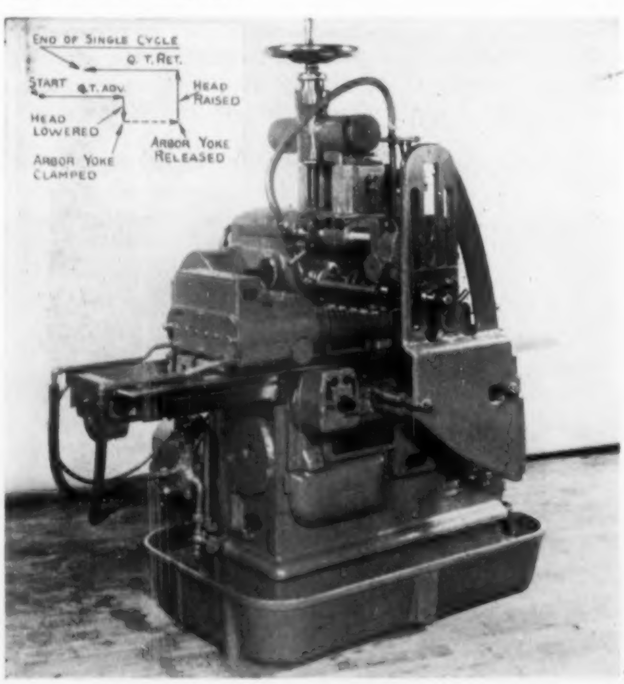
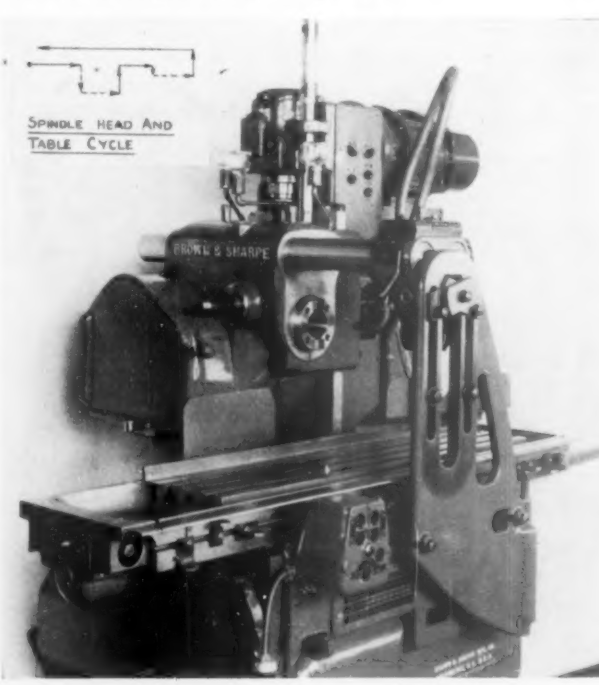


FIG. 7. An attachment for use with a standard machine tool, for use with work that requires two vertical positions.



the other is cutting, without the fear of the table reversing before he has finished loading.

The operation is to mill the form on a lock bolt. The work is loaded, four pieces at a time, in a vise-like fixture, and milled by four concave formed cutters, climb milling the work in the L. H. fixture, and conventional milling in the R. H. fixture. Mechanical clamping was used on this fixture to eliminate expense and also because ample time was available to maintain maximum production.

Fig. 9 shows a setup for grinding the complete shape of back, three pieces at a time, of supercharger buckets. Processes, in the development of this piece, required considerable engineering because of the shape of the form. This grinding opration was many times faster than milling and, while both of these operations were later discarded because of the lost wax method of casting to true form* the method employed has so many applications that it may well be described.

Grinding to Master Former

Speaking in past tense, therefore, the grinding wheel was dressed by a power-driven dressing mechanism that produced the form by a diamond which traveled through a path controlled by the combination of a pivot and a cam. The slow feed motor, used to drive this dressing mechanism, was started by a push-button at front of the machine. When the diamond had travelled across the complete form, the motor reversed and the diamond returned to the starting position and stopped.

The oscillating movement of the form grinding mechanism was controlled by a master former inside the mechanism. As the work spindle of the mechanism revolved, this master, —held in contact with a round dick by spring pressure—oscillated the work from a fulcrum above, the wheel grinding the correct form.

As each arbor held three workpieces there were three distinct forms on the master. For each revolution of the master, therefore, three pieces of work passed the grinding wheel.

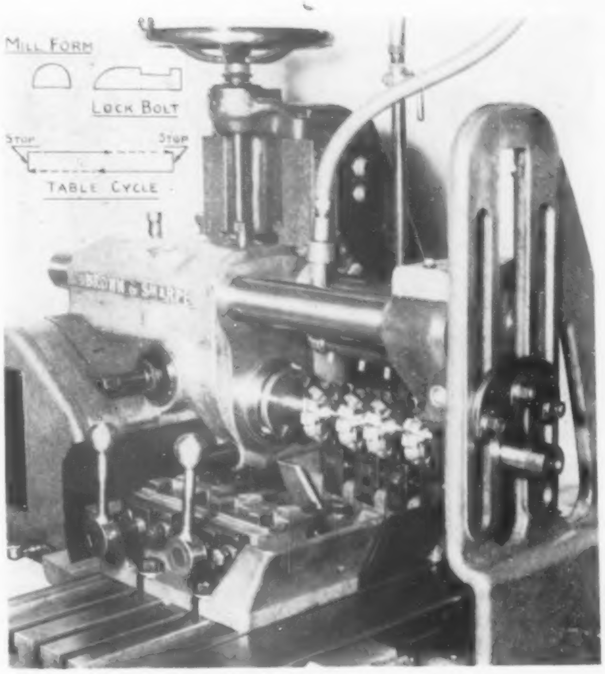


FIG. 8. An application of right hand and left hand fixtures, one working while the other is loading.

A method used for grinding a formed channel in an articulated rod is shown in Fig. 10. As these channels have double tangent radii at each end, a small wheel with a rise and fall action must be used. This rise and fall action is obtained by an angled master former mounted on the rear of the reciprocating table.

An angled roller is fastened to the vertical wheel slide, and as the table travels, the roll in contact with the former raises and lowers the wheel slide and the correct form is ground. To change the rate of table travel, at both ends

*See "The Process and Application of Lost Wax Casting," by H. W. Giesecke in July issue, the *Tool Engineer*.

FIG. 9. Set up for grinding supercharger buckets, 3 pieces at a time. While the method was superseded by lost wax casting, it has broad applications.

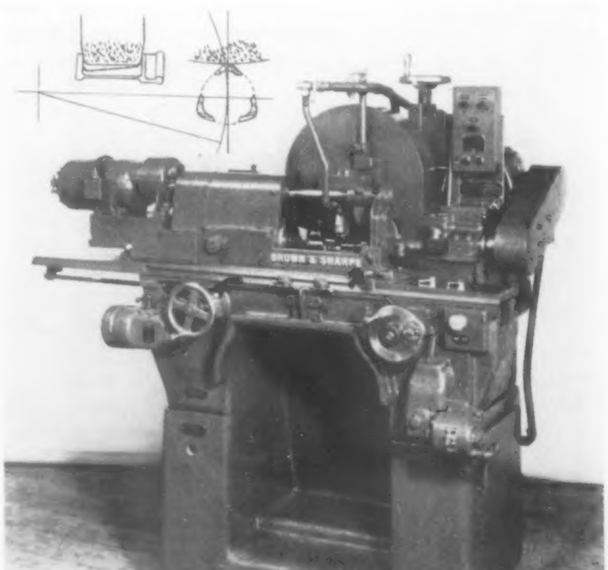


FIG. 10. Method used to grind a formed channel in an articulated rod.

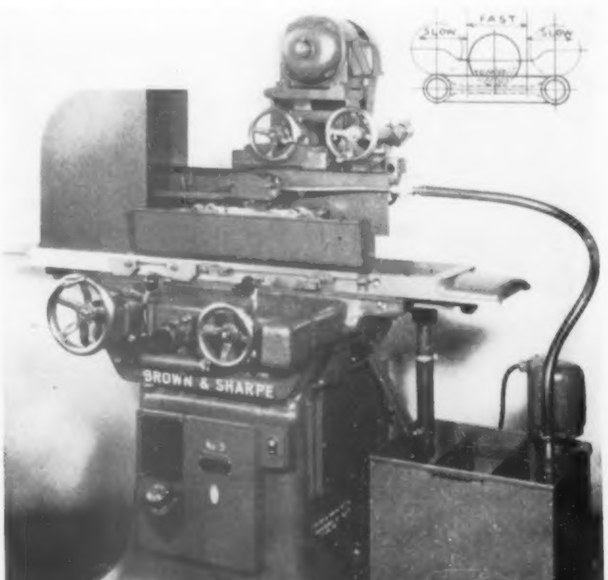


FIG. 11. An automatic indexing turret mechanism used to grind the large diameter of a copper floodlight post.

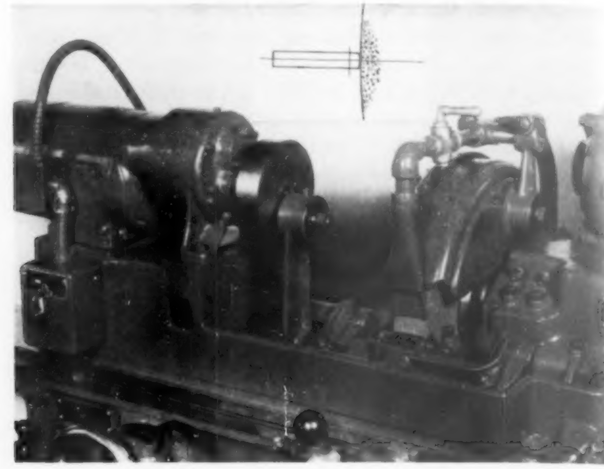


FIG. 12. A fixture used to grind the edge radius of a pump vane.

of the channel automatically, we use two dogs set on the table which controls the speed throttle by means of a special tie-in.

Fig. 11 shows an automatic indexing turret mechanism, used to grind the large diameter of a copper flood light post, which the operator has only to load and unload. The automatic cycle of the machine is all controlled through a cam shaft, inside the machine, which is constantly revolving. The cam moves the wheel slide forward at a fast approach speed; then, a slower rough-grinding speed, a still slower finish grinding speed, and a dwell for sparking out and a sizing follows in the order stated. The cam then moves the wheel slide backwards at a fast return speed, and then dwells.

During this dwell, the cam shaft trips the automatic indexing turret mechanism. This ejects the ground piece from the headstock spindle to a turret station, the turret indexes and carries an unground piece in line with the headstock, then moves forward forcing the work on the tapered headstock spindle nose in the grinding position. The operator then replaces a ground piece with an unground one, in the loading position of the turret, while the wheel slide is going through its automatic grinding cycle. A workpiece is finished for each revolution of the cam.

In Fig. 12 is shown a fixture for grinding the edge radius on a pump vane, with the grinding finish in the rotation of the vane. Because of the requirements that the grinding finish *must* be in the direction of the rotation of vane, and because of the fact that the work is too wide to be rotated, the operation must be done in a fixture that is supported on trunnions on either side of the work. The oscillation is obtained by a crank movement from a slow speed, geared head motor. Adjustment of the throw of the crank is provided for correct amount of oscillation, although several adjustments, in the work fixture, may be necessary to enable the operator to locate the work in proper relation to the oscillating center.

Diesels and the Oil Industry

Addressing the Oil and Gas Power Division of the A.S.M.E. at the recent annual meeting in Milwaukee, A. W. McKinney, Vice-president of the National Supply Company, opened his talk with the comment that: "There is no greater paradox in all business than the fact that the very industry responsible for the birth of the diesel engine still is almost a virgin field for the use of diesels, for without oil there could have been no diesels."

Mr. McKinney

Continuing, the speaker summarized the background reasons for increased use of diesels by the oil industry. He explained that, although natural gas was once considered inexpensive and widely used by oil companies for gas engines and steam boilers, the situation is rapidly changing because natural gas is finding other and more valuable uses in the oil fields.

Feeling that the outlook for increased use of diesels has never been better, Mr. McKinney went on to list specific cases where such increases will probably occur in the oil industry: (1) Drilling operations will need more diesels. Because of the greater depth to which wells are being driven, diesels can readily supply the heavy-duty power. (2) Oil companies plan to build more central engine-generator plants developing "electric power to serve a number of wells in an area, each powered individually by electric motors. Since natural gas is no longer considered cheap and abundant, it is expected that diesels will replace many of the gas powered installations."

(3) Experimentation on diesels as prime movers for the main pumps on oil lines is leading to still another market for diesels. Such diesel pumping engines have the added advantage of using oil as fuel which has been taken directly from the pipe lines. (4) The refining division will demand more diesels, too, predicted Mr. McKinney, and he pointed out that already some refineries are using diesels for driving large recycling pumps in refining operations. (5) Also, foreign diesel sales should increase materially. This should come about, not only because diesels have been favorably accepted abroad for many years; but, because there will be "an increasingly larger percentage of exploratory drillings and fewer proven areas where gas is available." Thus, diesels will more than likely gain ready acceptance from foreign oil operators.

While Mr. McKinney confined much of his Milwaukee speech to the use of diesels by oil companies, he also emphasized that diesels will play an important role in meeting future requirements for all industrial applications.

By E. A. Cyrol

The Tool Engineer and the Time Element

Savings, in Time and Cost, Should Be Designed into Tools and Fixtures

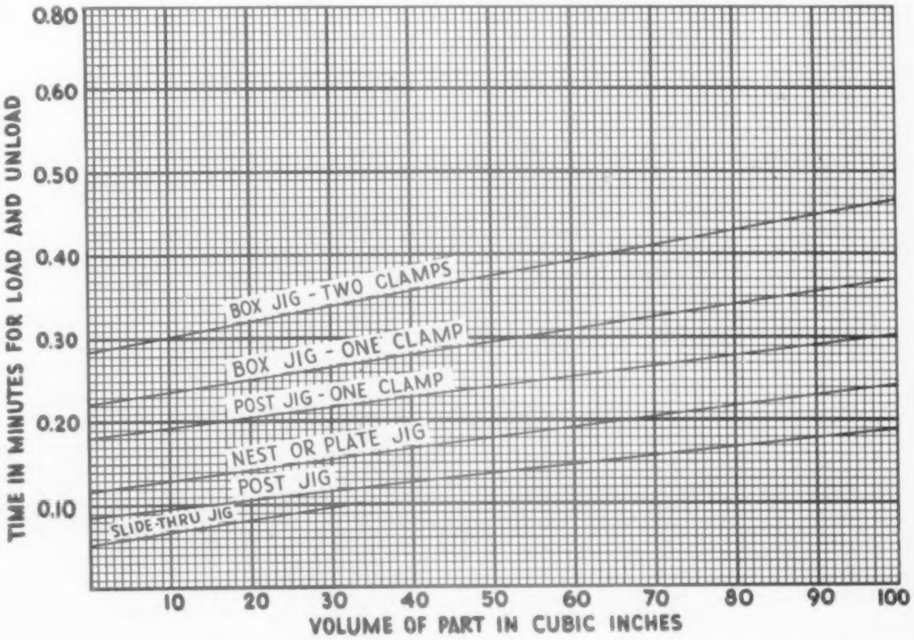
It seems to be generally accepted that a factory worker who is informed, to some degree, about all the work that is performed in the plant in which he is employed is a more effective worker than one who wears mental blinders as far as operations other than his own are concerned. Some managements find it worthwhile to have an "open house," once a year or so, when the entire line of products is displayed and the worker is told where the particular operations he performs fit into the general picture. However, these same managements are hesitant about applying a similar prescription at their own level. Wouldn't the production control group, for example, be more effective in at least one phase of its activity if it knew the workings—and some of the problems—of the purchasing department? Certainly the tool engineer would design more economical tooling if he had available to him, and was thoroughly familiar with, the time study data that the industrial engineer has in his files.

E. A. Cyrol is connected with McKinsey, Kearney & Co., Management Consultants, Chicago, as consulting engineer. A graduate of the College of Engineering, University of Michigan, he gained practical experience in the automotive industry and has since specialized in plant efficiency.

A closer tie-in of tool design and time study functions is the topic here. The successful tool engineer has a sound respect for the time element, or labor cost. The point of this discussion is that this respect, implemented with time data, can inspire the tool engineer to turn out tools which will effect the best utilization of time by the worker.

Savings in time that the tool engineer can *design* into a jig or fixture cannot be realized in any other way. Consider drill press work, as an example. The time for loading and unloading the jig is determined by the type of jigs used and no amount of rearranging the tools involved will change it perceptibly. The graph shown in Fig. 1 is a comparison of the time necessary to load and unload several types of jigs found in a typical drill press department. It is evident that the time varies with the size of the part and the type of jig used.

FIG. 1 at right.



The industrial engineer develops a graph similar to the one shown as a means of creating standard time data for subsequent use in establishing production rates. The tool engineer, if he is aware that such a graph exists, can use it to determine the most economical jig considering the labor cost for load and unload jig, the initial cost of the tool and the suitability of the jig as dictated by dimensional tolerances and other requirements.

He can calculate with certainty that a part of, say 25 cubic inches in volume, will take 0.0880, 0.1100, 0.1483, 0.2110, 0.2490, or 0.3300 minute per piece for loading into jig and removing, depending on the type of jig used. This, in turn, would mean that if a production of 100,000 units per year were contemplated, the load and unload time might cost anywhere from $220.00 to $820.00, assuming labor costs at $1.50 per hour. The economy of using one jig for several different parts can also be established through this type of comparison.

Good Tooling Effects Savings

A similar picture can be found in the time study data for small punch press operations. It is common knowledge that ejecting a part out of a die by air is speedier than by hand. But too often the excuse for not providing for air ejection is that the additional expense would be repaid by "only a *slight* saving in handling time." Tables, such as are shown in Figs. 2A and 2B, tells how "slight" or how substantial the saving might be in fact. A comparison of the time values involved reveals exactly how much difference there is and precisely what expense in tooling would be justified by the saving.

Similarly, when strip stock is fed into a blanking die, the time varies according to the length of the strip positioned and the method used in locating it, whether by sight or with

the aid of an automatic stop. Fig. 3 shows the time difference. The point, here, is that a substitution of the actual figures for impressions and opinions will determine the best tooling for a given set of requirements.

To the cost minded tool engineer, the tables of time study data may reveal portions of factory operations which can be eliminated completely. Take the table in Fig. 4, as an example, which contains the time data for a coil winding operation. The time study department followed the cycle as it was performed in the plant and established times for the elements. After careful motion analysis the following elements were necessary: 1. Assemble chuck and start wire. 2. Wind coil. 3. Tie each side and/or tape two ends. 4. Remove coil from chuck. 5. Toss part aside on bench. 6. Co coils and place in tote pan. 7. Change spool of wire required.

Elements 5 and 6, combined, require 0.0327 minute piece, and there is a double handling here that the ti study man must allow for in this set-up. The tool engin would readily see that a trap door in the bench, that wo count the parts as they are dropped through, and gui them to a tote pan below, would eliminate 0.0155 minu per piece. Can't buy much for a 0.0155 minute saving, yo may say? But, the plant produces about 500,000 motors p

Fig. 2A—TABLE COMPARING TIME VALUES FOR SIMILAR STAMPINGS AIR EJECTED AND HAND REMOVED

Air or Automatic Ejection

Area in Sq. in.	*Time in Minutes Per Piece*	*Area in Sq. in.*	*Time in Minutes Per Piece*
.50	.0329	10.50	.0404
1.00	.0333	11.00	.0408
1.50	.0336	11.50	.0411
2.00	.0340	12.00	.0415
2.50	.0344	12.50	.0419
3.00	.0348	13.00	.0423
3.50	.0351	13.50	.0426
4.00	.0355	14.00	.0430
4.50	.0359	14.50	.0434
5.00	.0363	15.00	.0438
5.50	.0366	15.50	.0441
6.00	.0370	16.00	.0445
6.50	.0374	16.50	.0449
7.00	.0378	17.00	.0453
7.50	.0381	17.50	.0456
8.00	.0385	18.00	.0460
8.50	.0389	18.50	.0464
9.00	.0393	19.00	.0468
9.50	.0396	19.50	.0471
10.00	.0400	20.00	.0475

Fig. 2B—Manual Ejection

Area in Sq. in.	*Time in Minutes Per Piece*	*Area in Sq. in.*	*Time in Minutes Per Piece*
.50	.0408	10.50	.0512
1.00	.0412	11.00	.0518
1.50	.0416	11.50	.0524
2.00	.0420	12.00	.0530
2.50	.0425	12.50	.0536
3.00	.0430	13.00	.0542
3.50	.0435	13.50	.0548
4.00	.0441	14.00	.0554
4.50	.0447	14.50	.0561
5.00	.0453	15.00	.0563
5.50	.0459	15.50	.0575
6.00	.0465	16.00	.0582
6.50	.0470	16.50	.0589
7.00	.0475	17.00	.0595
7.50	.0480	17.50	.0601
8.00	.0485	18.00	.0607
8.50	.0490	18.50	.0613
9.00	.0495	19.00	.0620
9.50	.0500	19.50	.0626
10.00	.0506	20.00	.0633

Fig. 3—Table of Time Values for Positioning Strip Stock

Length in Inches	*Automatic Stop (Time in Minutes)*	*Location by Sight (Time in Minutes)*
1	0.0040	0.0180
1¼	0.0050	0.0183
1½	0.0060	0.0185
1¾	0.0070	0.0188
2	0.0080	0.0190
2¼	0.0090	0.0193
2½	0.0100	0.0195
2¾	0.0110	0.0198

Fig. 4—COIL WINDING TIME DATA

High Speed Machines

Assemble Form and Start Wire (All Sizes) .... .1320

Winding Time

Turns	*Time*	*Turns*	*Time*	*Turns*	*Time*
40	.0605	155	.0960	340	.1535
45	.0665	160	.0975	350	.1570
50	.0675	165	.0990	360	.1605
55	.0690	170	.1005	370	.1640
60	.0700	175	.1020	380	.1675
65	.0715	180	.1035	390	.1710
70	.0725	190	.1065	400	.1745
75	.0740	200	.1095	410	.1780
80	.0750	210	.1125	420	.1820
85	.0765	220	.1155	425	.1840
90	.0775	225	.1170	430	.1855
95	.0790	230	.1185	440	.1895
100	.0805	240	.1215	450	.1935
105	.0820	250	.1245	460	.1970
110	.0830	260	.1275	470	.2010
115	.0845	270	.1305	480	.2050
120	.0860	280	.1340	490	.2090
125	.0875	290	.1370	500	.2130
130	.0890	300	.1400	510	.2170
135	.0905	310	.1435	520	.2210
140	.0920	320	.1470	530	.2250
145	.0935	325	.1485	540	.2295
150	.0945	330	.1500	550	.2335

Tie Each Side (All Sizes) .... .1730

Tape Two Ends (All Sizes) .... .1780

Remove Coil from Form

Wire Size	*Time*	*Wire Size*	*Time*	*Wire Size*	*Time*
20	.0925	24	.0860	28	.0880
21	.0900	25	.0855	29	.0920
22	.0880	26	.0860	30	.0955
23	.0865	27	.0865	31	.1025

Place Part Aside .... .0172

Count Parts and Place in Pan .... .0155

Change Spool

2½"	4"	6"
.0736	.0344	.0245

…r in job lots, and two coils per motor means 1,000,000 …es 0.0155 minute or, roughly, $390.00 per year at $1.50 p… hour.

I… the tool engineer will study the time data for square …aring that is available in the well managed time study …artment, he will find that the length and width ratio … the sheet of steel sheared affects the cost of the blanks …duced. For example, suppose that a blank 50" x 18" is …uired, as shown in Fig. 5. It may be sheared from a sheet …at is 100½" x 18½" or one that is 50½" x 36½", as shown … the sketch in Fig. 6. However, the 50½" sheet can be …eared for 1.75 man-hours per 100 blanks whereas the 100½" sheet requires 2.00 man-hours per 100 blanks.

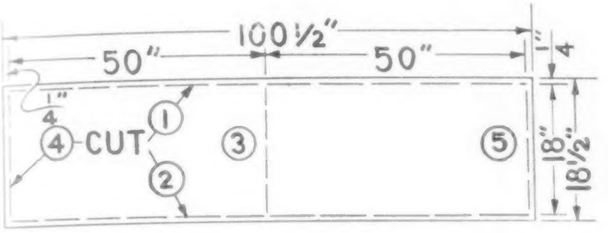
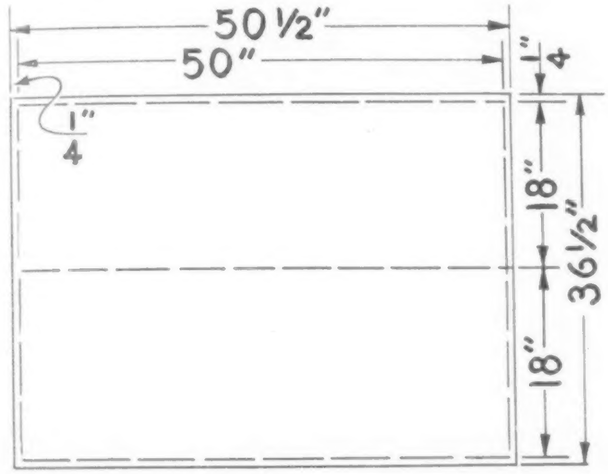


FIG. 5 above.

FIG. 6 below.



The longest time element in shearing a sheet of steel into relatively large blanks is the positioning element during which, in conventional handling, the operator brings the sheet from a truck or table to the gages on the shear for the first cut. Normally, the time for this element varies with the length of the sheet, as illustrated by the tabulated data in Fig. 7.

Too often, when a tool engineer specifies a set of cutting tools for a job, he has in mind higher speeds and heavier feeds than are actually used in the shop when the job is run. The operators and the foreman experience less trouble at the lower speeds and are prone to resist the time study man's efforts to increase them. Therefore, faced with the task of establishing production standards that can be met in the shop, the time study man accedes and establishes a set of feeds and speeds which are acceptable in the shop. The tool engineer can acquaint himself with these data through the tables used in the time study department. See Fig. 8. If he feels that the feeds and speeds thus established are too low, he is in vastly better position than the time study man to correct the condition since he has a greater knowledge of the factors involved and can more readily overcome the difficulties that the shop supervision brings up.

The number of small economies that can accrue from close cooperation between time study and tool design groups are infinite. But the sort of cooperation needed is not very common in the average industrial organization. Practically all time study forms have a section in which the time study man can put down his suggestions for improvements, and

FIG. 7—SQUARE SHEARING TIME DATA

Length of Sheet (Inches)	*Time for Positioning Sheet (Minutes)*	*Length of Sheet (Inches)*	*Time for Positioning Sheet (Minutes)*
20	0.0800	60	0.1300
22	0.0825	62	0.1325
24	0.0850	64	0.1350
26	0.0875	66	0.1375
28	0.0900	68	0.1400
30	0.0925	70	0.1425
32	0.0950	72	0.1450
34	0.0975	74	0.1475
36	0.1000	76	0.1500
38	0.1025	78	0.1525
40	0.1050	80	0.1550
42	0.1075	82	0.1575
44	0.1100	84	0.1600
46	0.1125	86	0.1625
48	0.1150	88	0.1650
50	0.1175	90	0.1675
52	0.1200	92	0.1700
54	0.1225	94	0.1725
56	0.1250	96	0.1750
58	0.1275	98	0.1775
		100	0.1800

FIG. 8—FEED IN INCHES PER REVOLUTION

Drill Diameter in Inches		*F.P.R.*	*Drill Diameter in Inches*		*F.P.R.*
1/16	.0625	.0030	15/32	.4688	.0095
3/32	.0938	.0035	1/2	.5000	.0100
1/8	.1250	.0040	9/16	.5625	.0105
5/32	.1563	.0045	5/8	.6250	.0110
3/16	.1875	.0050	11/16	.6875	.0115
7/32	.2188	.0055	3/4	.7500	.0120
1/4	.2500	.0060	13/16	.8125	.0125
9/32	.2813	.0065	7/8	.8750	.0130
5/16	.3125	.0070	15/16	.9375	.0135
11/32	.3438	.0075	1	1.0000	.0140
3/8	.3750	.0080	1-1/8	1.125	.0150
13/32	.4063	.0085	1-1/4 to 2		.0160
7/16	.4375	.0090			

SPEED IN FEET PER MINUTE
HIGH SPEED DRILLS

Material	*S.F.M.*	*Material*	*S.F.M.*
Soft Cast Iron	100	Brass and Bronze	200
Hard Cast Iron	70	Aluminum	200
Malleable Iron	80	Bakelite	100
Steel	70	Copper	150

time study files are bulging with such suggestions—but, nobody seems to read them!

Yet, those observations come from close analysis of the jobs as they are done in the shop, and they could be the bases of a never ending procession of improvements for tools because the time study man records the results of the performance of tools in the shop much in the same way as the test engineer records the results of the performance of a mechanism designed by the product engineer. The only difference is that the test and design engineers work as a team whereas, as a rule, the industrial engineer and the tool engineer do not usually so cooperate.

CHART FOR CUTTING FLUIDS

The chart below, covering cutting fluids for drilling, reaming and tapping, is compiled from data furnished by Headquarters Wage Incentive Dept., Westinghouse Electric Corp'n, Pittsburgh. It covers the experience of several years and, within reasonable limits, may be considered as a guide for use.

The Editors

MATERIAL	CUTTING FLUIDS FOR DRILLING		CUTTING FLUIDS FOR MACHINE REAMING	CUTTING FLUIDS FOR TAPPING
	Order of Decreasing Effectiveness	Order of Increasing Expense		
ALUMINUM AND ALLOYS	Kerosene Kerosene and Lard Oil Soda Water	Soda Water Kerosene Kerosene and Lard Oil	Mineral Lard Oil Kerosene Soda Water	½ Lard Oil and ½ Kerosene
BRASS	Dry Ker. and Min. Lard Oil —Deep Holes Soda Water—Deep Holes	Dry Soda Water Ker. and Min. Lard Oil	Soda Water	Light Min. Oil Dry
BRONZE	Min. Lard Oil Soda Water Dry	Dry Soda Water Min. Lard Oil	Soda Water	Light Min. Oil Dry
CAST IRON	Dry	Dry	Dry	Small Amts. of Min. Lard Oil, Soap or Tallow
COPPER	Min. Lard Oil and Keros. Soda Water Dry	Dry Soda Water Min. Lard Oil and Keros.	Lard Oil Soda Water	"Cresol Z-3"* and Par. Oil No. 3313-4 and Par. Oil
CAST STEEL			Lard Oil Min. Lard Oil Soda Water	
MAGNESIUM AND ALLOYS	Mineral Lard Oil Soda Water Dry	Dry Soda Water Min. Lard Oil	Mineral Lard Oil Kerosene Soda Water	Light Min. Oil
MALLEABLE IRON	Dry Soda Water (Deep Holes)	Dry Soda Water	Soda Water Mineral Lard Oil	Sulphurized Oil
MANGANESE STEEL	Dry	Dry		
MILD STEELS	Sulphurized Oil	Min. Lard Oil	Min. Lard Oil Soda Water	No. 3313-4 and Par. Oil
MONEL METAL	Min. Lard Oil	Soda Water	Lard Oil Soda Water	Lard Oil and Kerosene Sulphurized Oil
STEEL FORGINGS			Min. Lard Oil Sulphurized Oil Soda Water	
STAINLESS STEEL				Sulphurized Oil
TOOL STEEL	Min. Lard Oil and Keros. Kerosene Min. Lard Oil	Min. Lard Oil Min. Lard Oil and Keros. Kerosene	Lard Oil Sulphurized Oil Soda Water	Sulphurized Oil Lard Oil and Kerosene
TOUGH ALLOY STEELS	Soda Water	Sulphurized Oil	Mineral Lard Oil Sulphurized Oil Soda Water	Sulphurized Oil
WROUGHT IRON			Min. Lard Oil Soda Water	
MICARTA & BAKELITE			Min. Lard Oil	

* "Cresol Z-3" is an excellent heat dissipator and does not stain the work. It may be used in a 10% solution of Paraffin Oil.

By John E. Hyler

Graduating Operations

Methods and Machines for the Accurate Dividing of Scales and Dials

As in other forms of special work, graduating operations are performed here and there, on small lots of work, either by rigging up some specially-designed device in the shop for the purpose, or by using standard equipment, at hand, which will permit it to be done. For instance, machines have been designed and built, in various shops, for the purpose of graduating round collars; also, marking machines have been designed and shop-built for rolling numbers into graduated collars and similar parts, as a separate operation. It is hardly advisable to build such units, however, considering that equipment is available, from reputable makers, which will do a better job.

Mr. Hyler

In some instances, straight-line lineal scales have been graduated in small lots on a good horizontal milling machine, using a sharp-pointed tool held in the toolpost of a special clapper box. This clapper box is suspended from the milling machine overarm, care being taken to see that it is perfectly rigid. The clapper pivot must be so located that the tool has its arc of swing in the same plane with the axis of the overarm, and directly across the machine table.

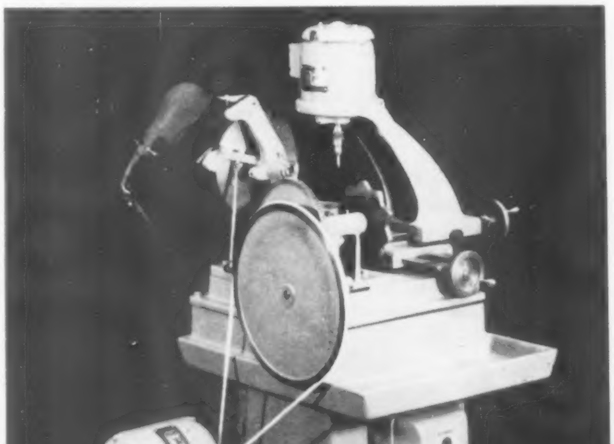
The workpiece is clamped to the milling machine table, with its edges parallel to the longitudinal travel of the table. The table is set at the correct height for the tool to make a graduating cut of the desired depth when the work is crossfed. A dividing head is used, and is geared to the milling machine table feed screw. The procedure is so obvious that, with the verbal description given above, an illustration seems hardly necessary.

With such a setup, it is a simple matter to calculate how many turns of the index crank will be necessary to move the milling machine table, the amount required, from one graduation to another. This depends both on the ratio at which the index head is geared to the feed-screw, and the desired value of the spaces left between graduations on the work. The table is first fed this amount longitudinally, with the index crank, and then it is cross-fed. Stops can be arranged, to vary the lengths of different graduation lines if desired.

Graduating on the Miller

At the end of each line, when the cross-feeding is stopped, the tool is tapped on the back with a light soft-faced hammer, causing it to swing up out of the cut on the clapper pivot. This leaves a nice terminus to each of the graduations. The table is then retracted with the crossfeed screw, until the tool clears the workpiece, is again advanced longitudinally the amount required with the index crank, and the cycle repeated. A little thought will make it obvious that graduations can be accurately made in cylindrical or conical surfaces at the milling machine, using a reliable dividing head, and either the longitudinal or the cross feed of the table, for making the actual cuts.

However, methods of the type described are not to be recommended in cases where there is any appreciable amount of graduating to be done, for it can be done so much faster and better on equipment especially made for the purpose. Some makers of metal marking machines have produced



Left, an automatic graduating machine of the type described in the text. The workpiece is mounted on a simple fitting and held with a drawbar. The cam for governing graduated line lengths, and the notched master dial, can be quickly changed for setting up different kinds of work.

Below, many different types of work are efficiently graduated on an automatic graduating machine of the type using a cutter spindle for cutting the graduations. Some of them are shown here. Photographs by courtesy of George Gorton Machine Company, Racine, Wisconsin.

graduating equipment which is highly efficient. One unit observed is designed especially for putting graduations and their accompanying numbers around the periphery of dials, handwheels, and similar parts. There is a longitudinal or straight die mounted in the machine, and the arrangement is such that the part to be marked is clamped and caused to roll along the die. The marking is accurately sunk in the part during this process.

Power Machines Recommended

There are several graduating machines which use the general principle of a rolling pressure die on the work, instead of a longitudinal or straight-faced die. One unit, observed at work in different places, is found in different sizes, according to the parts to be graduated and numbered. As a rule, several sizes of parts can be graduated with the same machine, however, by changing graduating dies and gearing. Round parts varying in diameter from 4 to 12 inches are graduated on this kind of machine.

Compounds for the cross slides of lathes, and bases for swivel vises, are often graduated on such units. Machine tool parts requiring graduations for degrees, or for micrometer adjustments, and especially various micrometer collars used on milling machines, lathes and other precision units are similarly processed. Some of these machines are power operated, while others have a crank which is turned by hand, while pressure is applied to the revolving die and work by means of a foot treadle. On the power driven machine, all the operator has to do is to load and unload the workpieces.

A different and yet similar type of machine is used in many places for graduating standard micrometer collars. This machine is so designed that the die spindle and the work spindle can be drawn closer together, or spread farther apart, for handling work of different diameters. Micrometer collars in sizes as small as can possibly be placed on an arbor can be graduated on this machine, and from there up to workpieces 3½" diameter. It is obvious that a rotary die must have the same diameter as the workpieces it is to mark. Therefore, a special marking die is needed for each size of collar graduated. These particular machines are powered by a hand crank, and pressure is applied by means of a pedal, in the majority of cases. However, in a few instances, a clutch and motor have been installed on a special bracket, making it a power-driven machine.

In a considerable number of instances, standard types of marking equipment have been fitted with graduating facilities by their manufacturers. These graduating setups are usually not as efficient as regular graduating machines, but they do serve to bridge the gap in many plants having only a moderate amount of this work to do. In not a few cases, special graduating machines of rotary-die type have been designed and built, chiefly to handle a specific type and size of workpiece, which is to be graduated in large quantities.

A crank-operated graduation marking machine, designed strictly for round parts. The work-holding and the die-holding mandrels are geared together and roll the graduated markings and the numbers into the workpieces at the same operation. Photograph courtesy of Noble and Westbrook Mfg. Co., East Hartford, Conn.

One machine is built particularly for graduating the periphery of an aluminum disc, 12½" in diameter, with [illegible] divisions, and with numbers at every five divisions. Another was built especially for graduating the conical surfaces of time fuses, though it is also suitable for graduating other kinds of work. The graduating dies for the large-diameter work mentioned were made in four sections, and attached to the side of a gear, to make up the complete circular die. In this way, if a large rotary die becomes damaged at any point, it is only necessary to replace the damaged quadrant.

Special machines designed for marking graduations and numbers on flat lineal parts, such as square blades, scale bars and similar parts, combine swiftness of marking with precision, and are so far in advance of the milling machine method, on large lots of work, that there is no comparison. One such machine has a special work-holding table, mounted on roller bearings. Provision is made for traveling this table, with the work on it, by means of a rack and pinion, operated by a hand crank. The work passes under a circular revolving die. This die passes over the work twice, but the travel is exactly accurate, due to accuracy in the rack and pinion. There is a spring that holds the rotary die in pressure-contact with the work, while the table is being traversed.

In operation, a foot pedal is depressed, to release the pressure of the die. A piece of work is placed on the table, while it is at the forward end of its travel. There are gauges on the table, which locate the work properly, when it is placed. The pedal is then released, and the spring reacts to put pressure on the work and the die. The table is then traversed by the handcrank, forward and back again. The pedal is then again depressed for changing workpieces, and the cycle is repeated.

Automatic Index Machines

A different method of graduating makes use of a machine employing a cutter spindle. This is a highly competent unit, which indexes the work automatically, controls the accuracy of spacing very closely, and varies the lengths of lines cut, when desired, as well as for graduating. It will graduate either on the periphery or the face of the work, or on any conical surface. It has capacity for handling practically all work encountered as to size, in the average plant. Automatic indexing is provided for any number of divisions from 25 to 650, within 360 degrees. Lesser numbers of graduated divisions than 25 may be obtained, but this must be done by hand indexing.

The number of graduations cut automatically is governed by a notched master dial, and the number of notches on this dial determines the maximum number of evenly-spaced graduations it will index. However, using the proper feed adjustment, any number of graduations that can be divided equally into this number of notches, can also be indexed with the same dial. Different dials can be used for different graduating jobs, as required.

Variations in lengths of graduating lines are obtained through the use of cams, one cam being required for each dial having a different arrangement of graduations. Some cams govern the work and cutter spindle in such manner as to cut two different lengths of lines. Others permit cutting three different lengths. The machine can be adjusted to obtain any length from zero to ⅜" for the shortest lines. The maximum length of line that can be cut with any cam is 11/16". Various optical cutter spindle equipment may be used, to adapt this machine for out-of-the-ordinary types of graduating work, when desired. For instance, much higher-speed spindles can be employed, for cutting certain types of graduated lines on the face of aluminum and similar soft material dials.

By Phil Glanzer

The Metallurgy of Oxy-Acetylene Welding

In Which the Author Discusses the "Little Things" That Make the Difference Between Success and Failure in Flame Welding.

Mr. Glanzer

Oxy-Acetylene welding of steel involves heating the metal from room temperature up to and beyond its melting point. Hence, in a metallurgical study of the process, it is necessary to consider all of the effects—physical, metallurgical and chemical—that can take place in steel over that entire temperature range both in the solid and liquid condition. The study, therefore, covers physical changes such as expansion and contraction, metallurgical effects such as crystallization, heat-treatment and the effect of alloys and all the chemical reactions of liquid steel with its surrounding materials.

The fact that welding usually progresses along a joint or fracture, and that surrounding the point of welding all temperatures are present from normal to that of liquid metal, adds greatly to the difficulty of accurate metallurgical study of the system.

Expansion and Contraction

The simplest phenomenon which happens to solid steel on heating is, of course, expansion. In the initial stages, and in unrestrained metal, this is purely a change of volume and, in ordinary steels, a completely reversible change regardless of the rate of heating or cooling. At the same time that it is expanding, the steel becomes increasingly soft, ductile and weak, a fact that has both advantages and disadvantages. Due to this fact, stresses become dissipated and advantageously spread over a wide area because of the ease with which the steel can stretch and yield. Especially is this true in oxy-acetylene welding, where a considerable area is heated at one time.

On the other hand, the low strength at these elevated temperatures makes it necessary to be certain that the piece being welded is free to move so that an undue load is not placed on the hot steel. Particular attention must be paid to the final welds of a closed structure, or in joining a light to a heavy section, in order to prevent the locking up of stresses in the structure or even in extreme cases causing rupture of the weld metal.

Practical Significance of Recalescent Point

When plain carbon steel is heated somewhat higher to a temperature (called the recalescence point) which depends on the composition of the steel, but lies in the neighborhood of 1400°F.—or a bright red heat—it goes through a metallurgical change of the greatest importance. At this temperature the carbon, which at lower temperatures has existed as discrete particles of iron carbide mixed with pure iron, goes into solution in the iron and at higher temperatures remains in solid solution—a condition analogous to salt dissolved in water.

On slowly cooling down through this temperature, the carbon is again precipitated or thrown out as iron carbide. The manner in which the precipitation takes place and, hence, the condition of the steel at lower temperatures, is profoundly affected by the rate at which the cooling takes place. When rapidly cooled, the steel is left in a relatively hard and brittle condition, whereas, if slowly cooled through this temperature, it is soft and ductile.

Welding with Low Carbon Steel Rods

The first oxy-acetylene welding of good quality was done with low carbon steel rods containing a minimum of other elements. The operation is quite analogous to the making of rimmed steel. In the heat-up of the base metal and the welding rod to the fusion point, both become coated with iron oxide, or scale. Several effects resulting from this fact have a direct bearing on the manipulation during welding and on the quality of the finished weld.

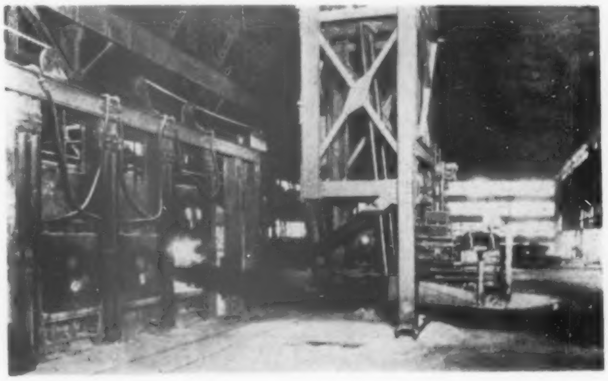
First, the scale on the surface of the metal melts at a lower temperature than the steel itself, hence, must be removed from the surface in order to get adhesion between the added metal and the base metal. The endeavor to be certain that this had been accomplished led to the melting of a considerable amount of base metal, giving a wide weld and excessive consumption of welding gases.

Also, in order to make sure that this liquid iron oxide was completely eliminated from the weld, it was necessary to carry the temperature of the metal well above its melting point in order to obtain the liquidity that comes with higher temperatures.

Further, the oxide dissolved in the metal reacted to some extent with the carbon, giving rise to blowholes. Also, the

The heat effect of the oxy-acetylene flame can be very easily controlled as compared to other methods of welding.

Open hearth steel practice may be termed analogous to steel welding by oxy-acetylene flame.



complete absence of silicon, manganese, and other deoxidizing elements prevented a cleaning action such as goes on in an open-hearth furnace during the manufacture of high grade steel. The carbon content of the rod had to be low to avoid excessive reaction between it and copious amounts of iron oxide that were present which would have led to a serious number of blowholes in the weld; the scale on the surface of the base metal effectively decarburized the rod metal, still further lessening the amount of strength-giving carbon in the weld; and the sluggish flowing qualities of the substantially pure iron weld metal led to the ripple type of weld since the metal had to be blown into place.

In spite of all these difficulties, and what now seems like welds having a very low order of strength, these welds served the early days of the industry well. To get good welds in those early days required a high degree of skill on the part of the operator.

Modern Steel Welding Rods

With growth of the welding industry, and increased knowledge of its difficulties and needs, came realization of the important role played by the rod aside from that of simply supplying metal to fill the scarf or vee. Rods were devised containing the elements on which the steel manufacturer relies for the production of high grade steel.

By the addition of silicon and manganese, the gas-forming reaction between carbon and iron oxide was minimized and replaced by a reaction between iron oxide and these metallic elements. Since the products of the reaction are solid, they do not result in blowholes and, with the proper balance between the silicon and manganese contents in the welding rod, the ratio of silica to manganese oxide is controlled so as to produce a fluid slag which readily floats to the surface of the metal. This effectively cleanses the weld metal as it does so and also blankets it against further oxidation. Eliminating the causes of the carbon-iron oxide reaction makes it possible to increase the carbon content of this type of rod and, consequently, of the weld metal to a figure comparable to the usual structural steel.

As a result, this type of rod yields materially higher strength as well as sounder welds. The strongly reducing elements in the rod remove the scale on the base metal without leading to further troubles, thereby presenting a clean surface for the weld metal to adhere to. This makes it unnecessary to melt deeply into the base metal. Further, the increased carbon, silicon and manganese in the weld metal materially lowers its melting point so that it flows well and is easily placed where desired. All of these factors reduce the strain on the welder and the amount of work that the welding flame must do. This leads to better technical results and, equally important, to lower costs.

More recently a further advance has been made, this time in the technique of welding which, coupled with the improved rods, makes modern oxy-acetylene welding a very different procedure from that of the early days.

Advantages of Carburizing Flame Technique

By using a carburizing or excess acetylene flame, the welding blowpipe is made to perform an added function over the usual preheating of the base metal and melting of the rod. The procedure depends on the fact that hot steel readily absorbs carbon, that high carbon steel has a much lower melting point than the low carbon steel, that carbon very effectively reduces iron oxide, and that carbon disperses or migrates through hot steel at a rapid rate.

Using the carburizing flame for welding and directing the flame backward over the completed weld, but in such a way that the excess acetylene flame touches the scarf or vee in advance of the welding puddle, serve first to reduce any iron oxide that may be on the surface of the metal. The reduction of the oxide leaves a very porous, spongy type of iron which very readily absorbs carbon from the flame. As a result, the melting point falls as the carbon increases until, with fully carburized iron, it is nearly 700° deg. F. below the melting point of carbon free iron.

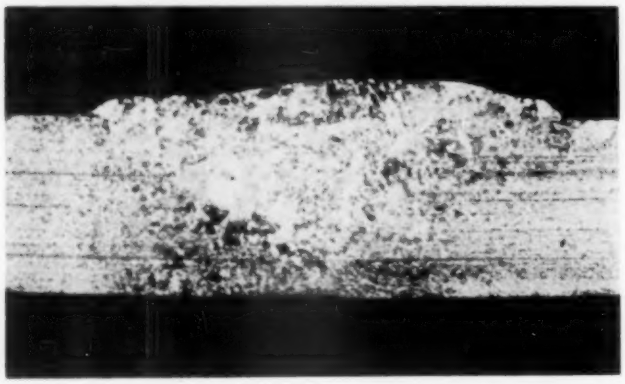
Moreover, the highly carburized, low melting point surface of the scarf is easily brought to a sweating condition in advance of the welding operation without any particular attention being paid to it by the operator. This condition is perfect for forming the union between the liquid metal from the rod and the base metal. There is no need for melting into the scarf to insure the presence of clean metal for this union, and the operator's attention is directed mainly to the operation of melting the rod.

As a result, the width of the groove need not be as great as in earlier methods, hence, less rod must be melted to fill it and this, together with the elimination of melting the scarf leads to rapid, easy welding at a reduced cost for welding materials. Needless to say, the highly carburized surface of the scarf is rapidly absorbed by the added metal and the carbon diffused uniformly through the weld while still at a high temperature giving a uniformly strong and ductile weld metal.

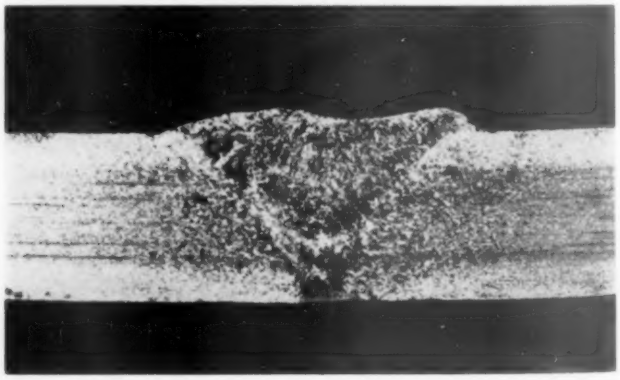
Another real advantage derived from this type of welding is the ease with which it can be made semi-automatic for certain applications. The reduced attention required from the welder at the focal point of the welding enables construction of an apparatus by which the rod is gravity fed as needed and which provides several flames each designed to carry out a particular function of the operation. As would be expected, all this leads to an ease and speed of welding impossible under earlier methods.

Acknowledgment is hereby made to The Linde Air Products Company for much of the source material and the photos contained in this article.

A neutral flame fusion weld shows this type of grain structure. Compare with photo at right.



The area of small grains, a result of welding, is advantageous because of greater ductility and toughness.



By **P. H. Winter**

Electric Circuits Applied to Motors

Wiring, Relays, Switches and Protectors for Manual and Remote Control

IN A PREVIOUS ARTICLE* we discussed some of the elements that go into the layout of electrical circuits. We will now proceed to a more specialized application, namely, the wiring of electrical motors.

Although there are alternating current, direct current and universal current motors, the large majority of motors used in special machinery are of the 3 phase alternating current type. It is, therefore, the purpose of this article to center discussion on A.C. motors and to only briefly touch on the other types since a good deal of information is common to all.

Mr. Winter

We will not discuss, here, the various types of motor windings and their characteristics, rather, shall consider the motors as integral items of machinery whose external leads have to be connected to provide certain control conditions. The simplest motors to install are those of about $\frac{1}{4}$ HP or less since they usually require but two wires and the current load is so low that they can be operated by practically any sturdy manually or mechanically operated switch.

Depending on the nature of the duty, a simple fuse may be installed to protect the motor from burning out its winding when overloaded. This fuse should be rated at from 1.25 to 3 times the normal full load amperage of the motor as appearing on the motor name plate. If this is not available the full load amperage for motors may be calculated as follows: If power factor is near unity, then (see Fig. 1) $\text{Amperes} = \dfrac{\text{Rated hp} \times 746 \times 1\frac{1}{2}}{\text{Line Voltage}}$; Amperes $= 8.1 \times$ hp for 110 v. ckt; $4.1 \times$ hp for 220 v. ckt; and $2 \times$ hp for 440 v. circuit.

For average industrial power requirements, motors over $\frac{1}{4}$ HP are usually of the squirrel cage 3 phase induction type which require 3 leads connected for operation. Two of these leads are considered power leads while the third is grounded to the line supply neutral wire. Motors up to 3 HP (depending on the voltage) may be started and stopped directly by means of manually or mechanically operated switches which, however, are of a special type since all three leads have to be connected and disconnected.

*"*Elements of Electric Circuits*," *April '46*, The Tool Engineer.

These switches are specifically designed for motor control and are usually supplied with built in thermal overload protection which will shut off the motor if it should operate under a continuous overload. These protection devices operate by melting a spot of solder, which in turn causes the circuit to be mechanically broken.

This overload protection—of which there are several types—is not quick acting and it may, therefore, be advisable to use fuses to protect the motor from high inrush currents. Again the fuses should be selected to carry about 1.25 to 3 times the rated full load amperage of the motor. In referring to Fig. 2, note that although three leads are used, only two require overload protection and fuses, provided, that is, that the unfused leg is grounded. Obviously, *the motor cannot run on one lead*.

Control by Magnetic Contacts

When it is required to operate 3 phase motors of $\frac{1}{2}$ HP and more, they are usually controlled by means of magnetically operated switches which are better known as magnetic contactors. These are an application of the self-locking relay shown in Fig. 5 in the April issue. They are installed because they can be used readily with automatic circuits and because their rapid action minimizes arcing, thereby permitting them to control induction motors up to 100 HP.

Their principle of operation will be most readily understood from Fig. 3, which shows a typical wiring diagram for a 3 phase induction motor with stop-start push button control. A master switch "A," also shown, would be installed since it permits working on the magnetic contactor without current flowing through it. This master switch is usually supplied in the same housing as the fuses "B."

Contact for the 3 power leads is made at "C" where "D" is an auxiliary set of holding or locking contacts operated by "K"* and "E" is the solenoid coil operating the contacts. That is, contacts "C" and "D" are operated by solenoid "E" through the rod "K." "F" is the start button and "G" the stop button. "H" are two overload protection devices which on carrying excessive current interrupt the control circuit. After "A" has been closed, when connection has been made by pressing start button "F" current flows from line 1 through contacts "H," through "E," through "G" and through "F" to line 3.

**Blank Arrow top center Fig. 3.*

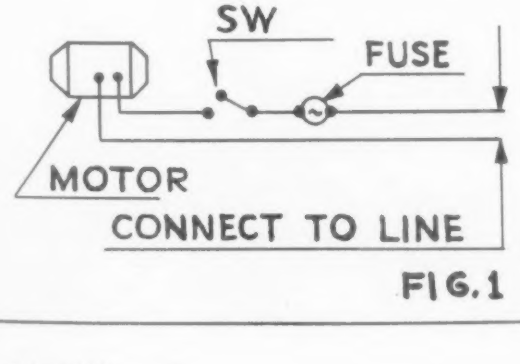


FIG. 1

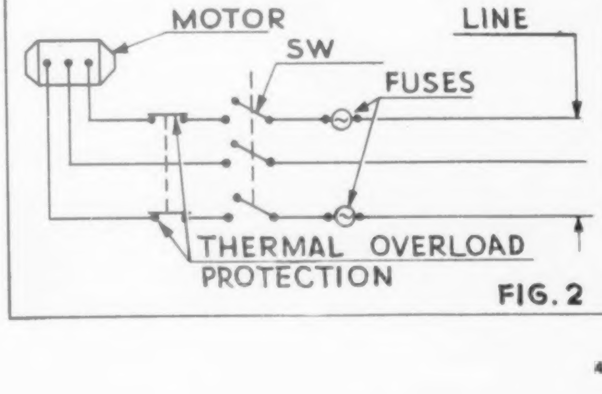


FIG. 2

Since coil "E" is now energized, it pulls down "K," closing contacts "C" and "D." The motor is now connected to the line and, since the coil is energized by current flowing from line 1, through coil "E" stop button "G," connection "L" and contact "D" to line 3, start button "F" can be released and the motor will remain running. In other words, the start button is now by-passed by the contactor "D," as a result of which the motor will continue to run when the button is released. When stop button "G" is pressed coil "E" is disconnected and spring action opens all contacts shutting off the motor. The same effect is produced if one of the overload devices breaks the control circuit.

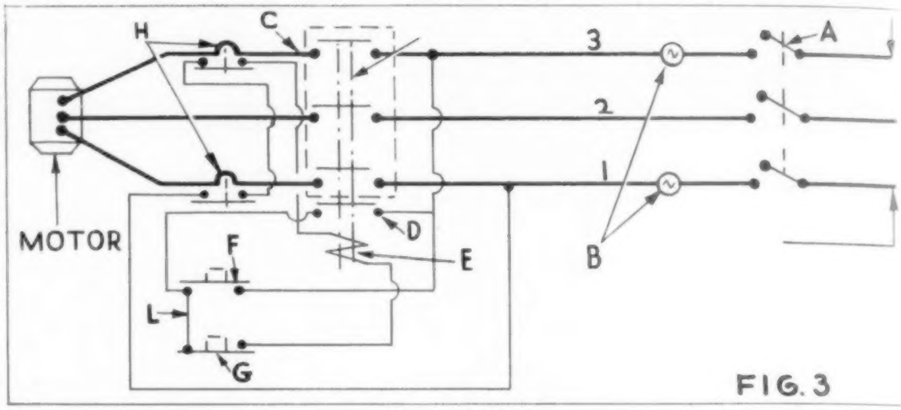


FIG. 3

It is readily seen that if an additional switch is placed in the stop button circuit opening it will also shut off the motor. This is frequently used in the installation of mechanically operated safety or emergency switches. The advantage of this set up is that the manually switched current is very small, merely enough to operate the solenoid coil "E." If it is desired to operate the motor by a different type of control any two momentary contact switches, one normally open and one normally closed, can be used instead of the push button station as long as each switch is connected the same as the push button station shown in Fig. 3.

There is practically no limitation to the variations that may be obtained by control wiring of magnetic contactors. They may be used with additional push button stations, liquid pressure operated switches, limit switches, time delay relays, electric or mechanical timers, or thermostats, etc.

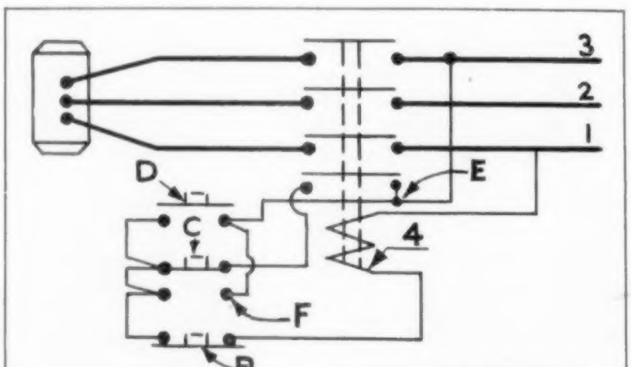


FIG. 4

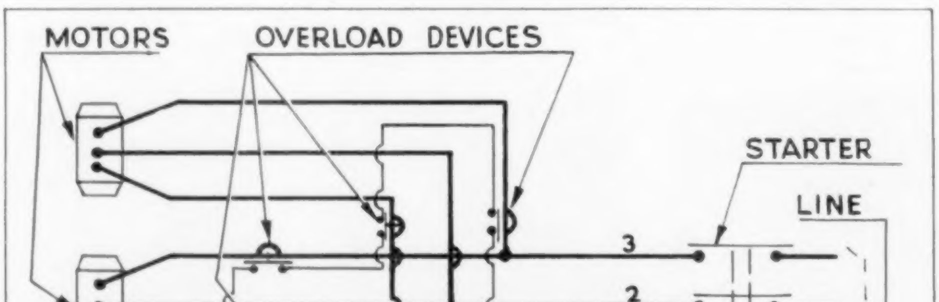


FIG. 5

Some of the more specific applications will be shown in a later article; we will, however, discuss the wiring required for the frequently used jogging or inching push button control. The same type of magnetic contactor, overload protection, master switch and fuses as previously described are used together with a triple push button station with jog attachment. It should be borne in mind that, while a jogging attachment is not absolutely necessary, it will prevent the starter from accidentally staying closed when the motor is being jogged.

When the jog button "C" is depressed, it closes contacts "F," which permit current to flow through the coil, energizing it and closing the starter. On releasing the jog button and opening contacts "F," the starter opens again and shuts off the motor which, therefore, runs only as long as the jog button "C" is depressed. When two or more motors are to start and stop at the same time, one common starter may be used but separate overload protection must be used for each motor as shown in Fig. 5. Overloading one motor will cause the control circuit to be broken and both motors to stop.

If a single phase motor is to be operated on a single phase circuit Figs. 3, 4, and 5 still apply. The only change will be that line 2 will be omitted throughout so that 2 leads only (No. 1 and 3) will be used. For operation on a 2 phase 3 wire circuit Figs. 3, 4, and 5 apply, the only change being that the terminal of the control circuit connected to line 3 in the diagrams should be connected to line 2. When connecting a 3 phase motor its direction of rotation may be reversed by switching lines 1 and 3 between the starter and the motor.

In closing, we would like to briefly mention D.C. motor starters. These are entirely different from the above described starters since a D.C. motor cannot be supplied with full load current at once. D.C. starters incorporate a resistance which cuts down the current taken by the motor armature and which is decreased as the motor speeds up. On reaching full speed the resistance is by-passed.

There are so many different types of D.C. motors available that it would be difficult, within the limitations of this article, to describe suitable starting equipment for all of them. However, direct current is seldom used now, and the starting arrangements discussed should enable designers to complete wiring diagrams for almost all installations.

By Anders Jansson

Potter & Johnston Introduces New Models

Old Line Automatics Improved to Meet Postwar Production Demands

PROGRESSIVE IMPROVEMENTS to the line of P & J Automatic Chucking and Turning Machines, during the past four years, have so improved the performance and flexibility of these machines that, to all practical purposes, they constitute entirely new models. Model 6DREL, shown below, is typical of the line.

On a basic design pioneered by the Potter & Johnston Machine Company, Pawtucket, R. I., for over forty years, these machines—including changes of speed and feed—are fully automatic from the chucking of the workpiece to and including the final knockoff and, as usual, two to four units may be assigned to an operator.

Employing unit construction throughout, with rigidity, speed and power entirely adequate for use of present day tungsten carbide tools, the tooling possibilities of these machines are practically unlimited for work within their range. Four automatic changes of spindle speed, automatic binding of turret following index, direct cross slide action and a constant, motor driven fast traverse for turret and cross slide all contribute toward maximum production.

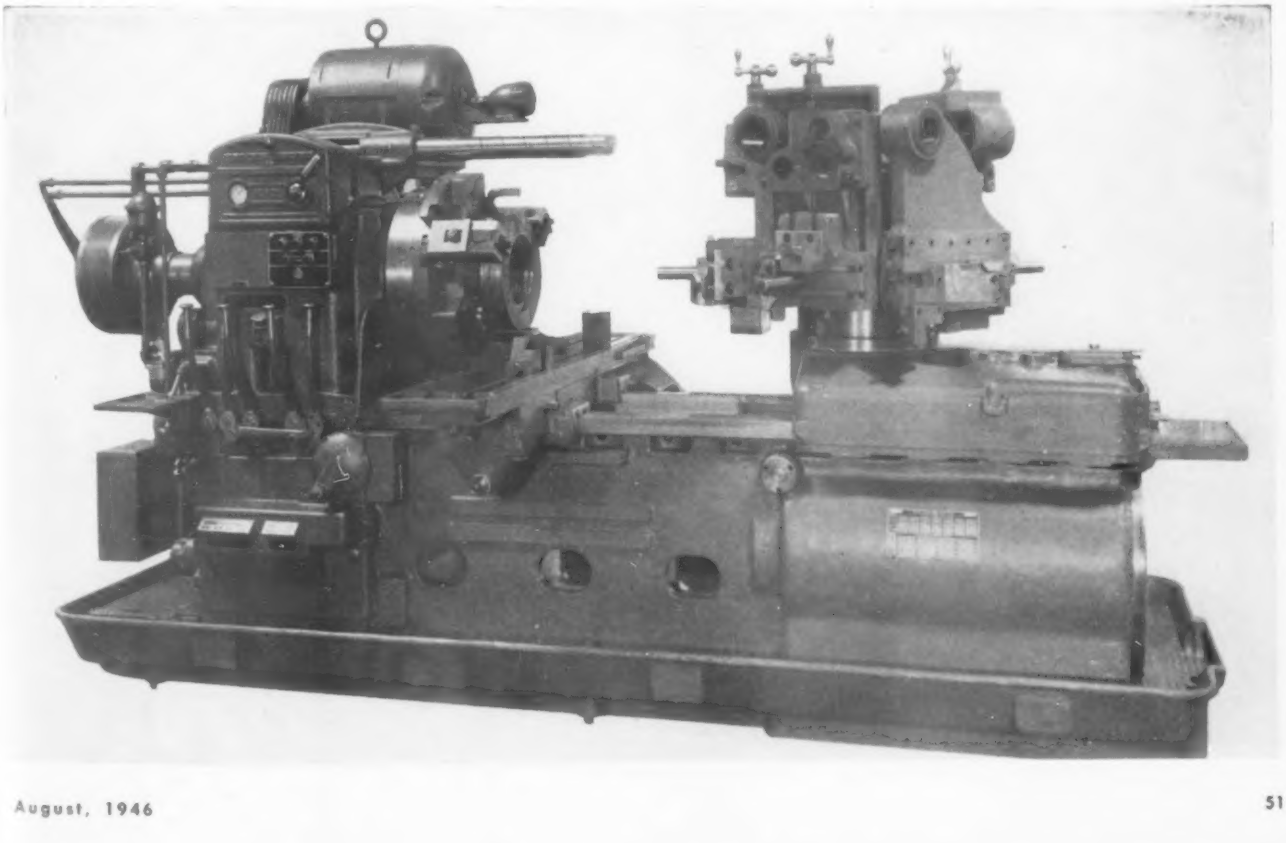
The base, a heavy, one-piece box section casting extending the full length of the machine, incorporates a large chip compartment easily accessible for clean-out. Hardened steel ways, of liberal dimensions and tongued and bolted to the base and ground in place, assure accurate and permanent alignment with long life and freedom from scoring. Telescoping dust guards exclude dust and chips from the turret drum.

The headstock, too, is a heavy one-piece casting, securely bolted to the base. The spindle, made from a high carbon steel forging, runs on oversize Timken roller bearings. The same is true of all shafts in the headstock, and headstock gearing (all helical) is of heat treated chrome nickel steel running in a bath of oil. The spindle speed range, arranged in 5 sets of 4 automatic changes, is from 9 to 167 rpm and any group of four automatic changes may be had through conveniently located pick-off gears. A high speed model, with speed range from 12 to 305 rpm, is also available.

Speed and feed range clutches may be operated manually (for setting up purpose only) or automatically by pneumatic cylinders, the air flow of which is timed by solenoid operated valves controlled by the dog drum. Feed change gears are of alloy steel running in oil.

Feed range is from .007" to .089" or from .007" to .250", in geometrical progression, and construction allows for three selective automatic feed changes. Rapid traverse is operated by a separate constant motor, and automatic spindle stop prevents scoring of work during tool returns.

Without going into detailed description, which may be had from the makers, it can be said that, with retention of the basic principles and quality of P & J line, plus marked improvements, the new models fully meet all of the requirements of the best "Tools of Today." Improvements are in line with the trend, in the machine tool industry, toward maximum production combined with operator safety, ease of handling and convenience in tooling and setup. As one of the "little things" that show forethought, the feed shaft is provided with a shear pin, in a safety clutch, that snaps off in event of excessive overload.



By Fred W. Steiner

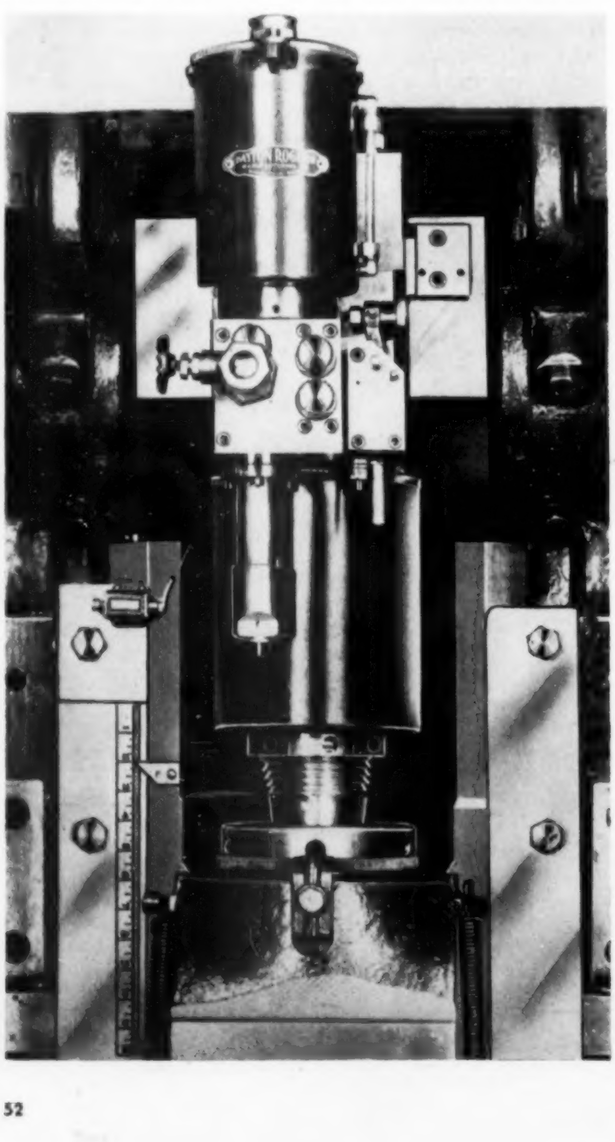
Hydraulic Overload Pitman for Punch Presses

New Accessory Replaces Standard Pitman or Connecting Rod on Punch Presses

A HYDRAULIC overload pitman, for punch presses, by the Dayton Rogers Manufacturing Company, Minneapolis, should be of particular interest to tool engineers both because of its safety features and its broad application to other industrial uses. The hydraulic linkage not only prevents bending and fracture of press crankshafts, and strains on frame members, but can be arranged to provide overload on dies and other tools, such as press assembly fixtures.

The photograph shows the device, as manufactured, installed on a press; however, the schematic circuit diagram will more clearly show its workings and principle of operation. Following the "cherries" from 1 to 26, in order, the details are:

(1) Oil level indicator; (2) intake filter; (3) overload exhaust line; (4) filler-bleeder line; (5) combination filler and bleeder valve; (6) high pressure outlet line; (7) overload valve; (8) overload adjusting screw, calibrated to read in tons; (9) pressure gage; (10) press slide; (11) ram adjusting screw; (12) slide adjusting nut, and (13) the piston.



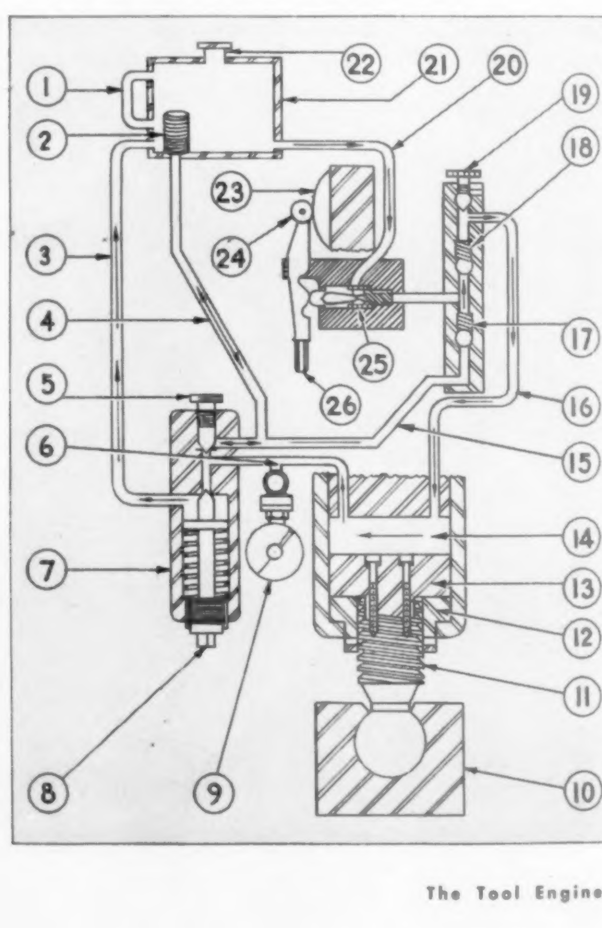
(14) The pressure chamber; (15) pump intake line; (16) pump outlet line; (17) and (18) check valves; (19) bleeder valve; (20) pump bleeder line; (21) oil reservoir; (22) filler cap; (23) cam; (24) cam follower; (25) pump; and (26) a hand actuator.

As applied, the ram of the press is adjusted by the screw (11) in conventional manner. Before the press is started, however, the cushion pressure—in chamber (14)—is built up by the hand actuator until the desired pressure registers on the gage (9). The press is then started and the pressure is automatically maintained by the action of the cam against the follower.

Should overload occur, the piston (13) retreats against the high pressure chamber (14), when the oil escapes through the overload valve (7) into the reservoir (21). This automatically reduces the pressure which, therefore, must be reestablished by the hand actuator (26) before press is ready to resume work.

The overload safety is usually set to protect the maximum rated tonnage of the press, and once the working ram is set for a given tool its position remains constant, at all times, as a result of the high hydraulic pressure in the cylinder.

At left, the overload pitman installed. Below, schematic diagram of the hydraulic circuit and incidental mechanisms.



A.S.T.E. NEWS

NEWS OF INTEREST AND ABOUT MEMBERS

Pittsburgh Prepares to Welcome Convention

Plant and Planetarium Tours Included in ASTE Program, October 10-12

THE NATIONAL PROGRAM and Host Chapter Committees have announced plans for the Semi-Annual Meeting of the American Society of Tool Engineers to be held in Pittsburgh, October 10-11-12. Preliminary details of the three-day, weekend schedule were made known after the meeting of these committees, July 12 and 13, at Hotel William Penn, Pittsburgh.

Authoritative discussions of timely technical subjects, visits to important industrial plants employing new production techniques, showings of engineering films, a banquet get-together with professional entertainment, and many special events, make up the comprehensive convention agenda.

Technical sessions, tentatively lined up, open Thursday afternoon, October 10, with Stephen Urban of Syracuse Chapter chairmanning a meeting devoted to "Welding and Design," followed in the evening by "Gas Turbine Tooling and Production," directed by Robert W. Ford of the Host Chapter.

Friday morning, afternoon and evening sessions will treat "Precision Castings," "Tooling with Carbides," and "Manufacturing Analysis," with H. E. Linsley of Northern New Jersey, E. W. Baumgardner of Cleveland, and O. W. Winter of Buffalo-Niagara Frontier Chapter in charge, respectively.

On Saturday morning, Fred J. Schmitt of Chicago Chapter will conduct the final lectures, dealing with various phases of "Multiform Grinding."

Cooler weather, promises First Vice-President W. B. Peirce, has been ordered by Pittsburgh Chapter for the Society's National Convention there October 10-11-12. Sweltering through two days of intense midsummer heat, the National Program Committee and the Pittsburgh Chapter convention committees met July 12 and 13 at Hotel William Penn, Pittsburgh, to plan the forthcoming Semi-Annual Meeting. Around the table, from left to right, are: G. P. Grace, Technical Meetings Arrangements Chmn.; F. J. Schmitt and R. W. Ford, Natl. Program Com.; G. C. Wood, Host Chapter; Stephen Urban, H. D. Hall, E. W. Baumgardner and F. E. Doty, Jr., all of the Natl. Program Com.; Harry E. Conrad, Executive Secretary; Mrs. Jean R. Wallace, meeting secretary; John F. Landis, Public Relations Director, Buhl Planetarium; W. S. Risser, Host Chapter; H. R. Shearer, Natl. Program Com.; Gardner Young, Reception Chmn.; William Owen, Banquet Chmn.; W. H. Schott, Chmn., and C. E. J. Brickner, Co-Chmn., Host Chapter Com's.; and Mr. Peirce. The Program Committee also worked on general projects.

Herbert D. Hall of Northern New Jersey Chapter, Chairman of the National Program Committee and an authority on industrial motion pictures, is previewing a number of engineering films from which he will select those most timely for showing at the Pittsburgh convention. Each morning during the meeting there will be a two and one-half hour program of "know-how" and "how-to-do-it" technical, screen presentations.

Visits to Local Plants

Tours of Westinghouse Gear Works and the Irvin Works of Carnegie-Illinois Steel Corp. will be conducted Thursday afternoon. Open house will be observed Friday morning and afternoon by Firth-Sterling Steel Co. (McKeesport); National Works of the National Tube Co., Mesta Machine Co., Westinghouse East Pittsburgh Works, Westinghouse Air Brake Co., and Aluminum Company of America (extrusion plant). The Thursday afternoon trips are to be repeated Friday.

Among the extra-curricular highlights of the convention will be special performances at the Buhl Planetarium, to be staged Saturday afternoon for ASTE members and guests. This $1,000,000 institution, dedicated to popular understanding of astronomy and natural sciences, is the newest of America's five planetaria and the most modern and complete institution of its kind. It is said that in this "Theater of the Stars" man is truly master of time and space.

Equalling the astral show in fascination are the huge projectors, telescopes and other equipment used to portray the drama of the universe. Representing one of the most remarkable engineering feats in the world of modern science, the construction and co-ordination of these devices will be of especial interest to tool engineers.

Banquet Saturday Evening

Concluding feature of the 28th National Meeting of the Society will be the Semi-Annual Banquet on Saturday evening, with a prominent industrialist as the principal speaker. Entertainment will follow the speaking program.

Convention Headquarters will be at Hotel William Penn where the entire 17th floor has been reserved for the scheduled activities, meetings of the Board of Directors and various committees, and gatherings of special conference groups.

The banquet and technical speakers, and additional events will be announced as the joint committees develop their plans.

National Program Committee members attending the convention organization meeting were: H. D. Hall, Chairman; R. W. Ford, First Vice-Chairman; E. W. Baumgardner, Second Vice-Chair-

(*Continued on Page 54*)

In This Issue

Induction Heating Capable of 50,000,000 Cycles

St. Charles, Ill.—High frequency induction heating was explained to members of Fox River Valley Chapter and local manufacturers at a dinner meeting held June 11 in Hotel Baker.

Dr. H. B. Osborn, Jr.

Dr. H. B. Osborn, Jr., Director of Research of the TOCCO Division, The Ohio Crankshaft Co., Cleveland, Ohio, discussed the theory of high frequency induction heating and the relative merits of motor-generator, spark oscillator, and electronic tube oscillator types of high frequency equipment.

He showed a series of picture slides, demonstrating the versatility of this special equipment in surface hardening and heat treating machine parts.

"The technique of high frequency induction heating as applied to industry was developed in 1936 by engineers of The Ohio Crankshaft Co.," Dr. Osborn said, "when the company was faced with the problem of surface hardening crankshaft bearings of giant, marine, diesel engine crankshafts."

He also pointed out that wartime requirements stimulated the development of this method of heat treating to the extent that today there are about 80 manufacturers of various types of high-frequency induction heating equipment.

Dr. Osborn further disclosed that the motor-generator sets, which can be designed to operate as high as 10,000 cycles per second at 50 to 70 kilowatts, are used in 90% of industrial applications. Spark gap sets at 200,000 to 400,000 cycles and electronic equipment capable of producing 50,000,000 cycles, are used in very specialized applications.

Author as Well as Lecturer

Dr. Osborn is a member of Cleveland Chapter, ASTE, as well as of several other prominent technical societies. He is the author of many scientific papers on induction heating and has lectured before various engineering societies in the United States and Canada. In 1943, he addressed the Semi-Annual Meeting of ASTE at Indianapolis.

At a recent meeting of Chapter officers, Chairman Herbert Braun appointed as new committee chairmen: Standards, Rudolph Berg, Chief Production Engineer, American Ironer Co., Algonquin; Education, H. E. Fink, Fox River Engineering Co., Aurora.

Editorial, W. V. Bault, Chief of Inspection, Western Condenser Co., Watseka, with Cyril H. Alltop, Production Engineer, Apex Mfg. Co., Elgin, and Ira C. Silvers of Aurora as assistants; and Membership, Daniel G. Bechtel, Homer B. Johnson Co., Chicago.

Future Chapter meetings, the officers decided, will be held on the first Tuesday of each month at the Hotel Baker, St. Charles. This location is considered the most central and convenient for the entire membership, many of whom live in the surrounding communities of Joliet, Aurora, Sycamore, Woodstock, Elgin, Geneva, Huntley and Algonquin.

Membership Goal Set at 100

The year-old Chapter, whose membership now totals 86, plans to increase its numbers to 100.

During the executives' conference, it was announced that the first regular meeting of the fall season would take place September 3, with Jan Taeyaerts, President of the Precision Diamond Tool Co., Elgin, as the speaker.

Mr. Taeyaerts will show motion pictures of African diamond mines and diamond cutting. A native of Belgium, Mr. Taeyaerts represents the fifth generation of a family long-established in the diamond business.

(*Continued from Page 53*)

man; Stephen Urban, Secretary; F. J. Schmitt, F. E. Doty, Jr., and H. R. Shearer.

The Host Chapter Committees were represented by Pittsburgh members: W. H. Schott, Chairman; C. E. J. Brickner, Co-Chairman; G. P. Grace, Technical Meeting Arrangements; Gardner Young, Reception; William Owen, Banquet; D. L. Bardes, Accommodations; W. S. Risser and G. C. Wood. J. P. Wiley, Chairman of Plant Tour Arrangements, was unable to attend the meeting.

First Vice-President W. B. Peirce of Pittsburgh, Executive Secretary Harry E. Conrad from the Central Office, and John M. Cannon of the Public Relations Department at National Headquarters, were also present.

Following the convention arrangements sessions, the National Program Committee reconvened to work on its general plan for national and local activity and to formulate more extensive services to Chapters.

National Officers Guest Speakers at New Haven

Several incumbent and past National Officers participated in the program of June 14 dinner meeting held by New Haven Chapter at Wilcox Pier Restaurant, Savin Rock, West Haven, Conn. In the group shown above are (left to right): Fred J. Dawless, Past Chairman, New Haven Chapter and Past National Director, who was Toastmaster for the evening; I. F. Holland, Third Vice-President; Frank Shute, New Haven Chapter Chairman; A. H. d'Arcambal and Ray H. Morris, Past Presidents. Speakers also included V. H. Ericson, National Treasurer. During dinner "Fabio and Son" rendered accordion selections. At conclusion of speaking program, "The D'Argonnes" entertained audience with magic.

Coming Meetings

BOSTON—Past Chairmen's Night, September 12, 6:30 P.M., Schrafft's Restaurant, 16 West St. Speaker: Harry Coopland, Special Representative, Jack & Heintz, Inc., Cleveland, Ohio. Subject: "Seeing Is Believing."

BUFFALO-NIAGARA FRONTIER — September 11, Milton J. Brounshidle Post, American Legion, Delaware Ave., Kenmore, N. Y. Program sponsored by Buffalo plant, Chevrolet Motor Div., General Motors Corp.

DAYTON—September 9, 6:30 P.M. Place to be announced. Speaker: William H. Oldacre, President, D. A. Stuart Oil Co., Ltd., Chicago, Ill. Subject: "168,000 Variables Are Possible Factors in Metal Cutting."

DECATUR—September 9, 6:30 P.M., Decatur Club. Speaker: J. Robert Moore, Representative, Moore Special Tool Co., Inc., Bridgeport, Conn. Subject: "Of Interest to the Tool Engineer."

ERIE—Ladies' Night, September.

FLINT — September 19, 6:45 P.M. Fischer's Hotel, Frankenmuth, Mich. Speaker: G. E. Brumbach, Metallurgical Engineer, Carpenter Steel Co., Reading, Pa. Subject: "Tool Steels and Their Applications."

FOX RIVER VALLEY—September 3, Hotel Baker, St. Charles, Ill. Speaker: Jan Taeyaerts, President, Precision Diamond Tool Co., Elgin, Ill. Subject: "Diamond Mining and Cutting."

HAMILTON — Thursday, September 12, 6:30 P.M., Fischer's Hotel. Speaker: O. W. Winter, Vice-President, Acme Pattern & Machine Co., Buffalo, N. Y., and National Education Chmn., ASTE.

PITTSBURGH — Semi-Annual Meeting, ASTE. October 10-11-12, Hotel William Penn.

TORONTO—September 9. Speaker: C. R. Alden, Research Engineer, Ex-Cell-O Corp., Detroit, Mich. Subject: "Precision Boring."

WILLIAMSPORT—September 9.

ASTE Officers Confer At Mountain Retreat

Meredith, N. H.—The ASTE National Officers held a two-day meeting, July 5 and 6 at "Clovelly," the summer residence of President A. M. Sargent of Detroit.

Assembled around a conference table in a pine-scented grove on the shores of Lake Winnipesaukee, the chief executives threshed out many of the problems confronting the Society in its current program of widespread activities.

In addition to Mr. Sargent, the host, officers present included: First Vice-President W. B. Peirce of Pittsburgh, Third Vice-President I. F. Holland of Hartford, Conn.; National Secretary R. B. Douglas of Montreal, Que.; National Treasurer V. H. Ericson of Worcester, Mass.; Assistant Secretary-Treasurer W. A. Dawson of Hamilton, Ont.; and Executive Secretary Harry E. Conrad from the Detroit office.

Robert B. Powers of Detroit, Executive Editor of *The Tool Engineer*, also attended the meeting.

Only National Officer not present was Second Vice-President Thomas P. Orchard of New York City.

The midsummer council was the third successive annual gathering of the Society's officers at Mr. Sargent's estate.

A•S•T•E• *Productioneers*

YOUR CENTRAL OFFICE STAFF

WHAT MAKES the wheels revolve in a big organization? How does one of America's largest technical societies maintain contact with its far-flung membership? Who writes the letters, receives and disburses funds, processes membership applications, records changes of address, makes arrangements for committee meetings and conventions,

Executive Secretary Harry E. Conrad looks up from his morning mail to greet a visitor at the Society's central office in Detroit.

and handles the mountains of outgoing mail to keep the wheels of the American Society of Tool Engineers turning smoothly?

These questions will be answered in a series of articles designed to introduce to the Society's 18,000 members the nucleus of their organization, the Central Office staff. In this issue, you meet the people who direct ASTE's myriad activities.

To pinpoint the spot in which all National activities of the American Society of Tool Engineers are born, let us look into the corner office of Executive Secretary Harry E. Conrad, on the 16th floor of Detroit's towering Penobscot Building.

Inspires Confidence

The Executive Secretary is tall, well-built, pleasant-featured and affable. He carries his responsibilities gracefully and his countenance reflects easy confidence.

Mr. Conrad is the liaison between the Society's Chapters, its officers, members and staff. On his desk is the morning mail, copies of correspondence between officers informing him of progress in current projects, plans for new ones and the success of Society policies in specific applications.

There are letters from officers and committee chairmen which will be placed before the various Committees. The Executive Secretary arranges for committee meetings, regional meetings and other functions in Detroit or at any point throughout the length and breadth of America.

Mr. Conrad's first assignment when he joined Central Office last November was to direct the enormous New Era Exposition and Annual Meeting at Cleveland. He came to the Society's home office with a background that had conditioned him to accept such challenges with untroubled determination.

The Executive Secretary served as Manager of the War Products Division of the Automotive Council for War Production during the war years. He was educated in the public schools of his native Albion, Mich., where he attended Albion College before advancing to the University of Michigan and the Detroit College of Law. He accumulated a wealth of technical knowledge during a long association with the automotive industry.

Farming His Avocation

Although Society work frequently takes him out of town, he still finds time to enjoy his hobby of farming which he shares with Mrs. Conrad and their 17-year-old son, John, on their pleasant acres near Holly, Mich.

Now let us meet the Executive Secretary's right-hand man, Office Manager Charles J. Hasse.

Mr. Hasse interviews all aspirants to ASTE office positions, as well as sales representatives. He is charged with ordering the huge quantities of forms, supplies, and printed matter which are needed to carry on a large business. Accounts receivable and accounts payable have his close scrutiny.

The Office Manager co-ordinates office schedules, keeps charts and graphs depicting the status of all projects and decides when it is feasible to initiate new assignments. He plots the order of operations for mailing campaigns so that members in California may receive their communications at approximately the same time that delivery is made to Detroit members.

He is regarded as the Production Engineer of the staff and, as staff consultant, maintains harmony, arranges vacation schedules and other personnel matters.

Mr. Hasse, like the Executive Secretary, enjoys working in the rich, black soil of Michigan. During the crop-growing season, he and Mrs. Hasse can be found nearly every weekend at their farm near Carlton, Mich., where they raise grain for starving war victims.

Formerly with Ordnance Office

The Office Manager came to Central Office two years ago from the Fiscal Audit Branch of the Detroit Ordnance District. Earlier, he spent several years with Phillips Petroleum Company, serving in various capacities.

Secretary Maxsine June Erickson is the "Girl Friday" and general confidante of the Office Manager. She takes his dictation, assists him in checking invoices, handles subscriptions to *The Tool Engineer* and the processing of multigraphed or printed letters.

It's Maxsine who makes the thousands of entries required to keep Armed Service membership records up-to-date, informing such members of their Society status.

Before each ASTE convention, she gathers reports of National Committees,

(Continued on Page 56)

Below: Maxsine J. Erickson, Secretary to Office Manager Charles J. Hasse, shows her Scandinavian good humor. Corner: Mr. Hasse, checking financial reports, is pleased at accuracy and dispatch with which they have been compiled on the new, automatic mechanical equipment. Right: Elizabeth Stander efficiently transcribes Mr. Conrad's letters, pertaining to the many ramifications of the Society's business and activities.

(Continued from Page 55)

arranges for their processing and distribution, and makes hotel reservations for committees and officers. She attends committee meetings and prepares reports on their activities for the National Secretary.

Attractive, blonde Maxsine has attended conventions in Milwaukee, Indianapolis, Philadelphia and Cleveland, as well as two in Detroit. Some of her records thereof have been incorporated in the compact, easy-to-read abstracts which you received at the conclusion of these events.

Maxsine's new-found hobby is golf. Although she is only a beginner, she does 18 holes in an average of 130 and on a few occasions has gone around nine in 52.

She was graduated from New Richmond (Wis.) High School in 1938 and came to Detroit a year later. She joined the ASTE staff four years ago after serving with the Army Air Force Central Procurement District and the Universal Credit Corp. in Detroit.

Plays Roving Center

Soft-voiced Elizabeth Stander plays roving center on the ASTE management team. Just now she is taking all of the Executive Secretary's dictation, acting as assistant in the newly-formed Public Relations Department, handling many details concerning committee meetings, and winding up the business of the New Era Exposition.

Quiet, efficient and dependable, she had a major role in the Society's mammoth Exposition in Cleveland last April. Her work of keeping up with applications and assignments of exhibit space and acting as general assistant to several Central Office attaches will long be remembered because much of the show's success depended on her care and diligence.

Elizabeth came to Detroit from Akron, Ohio, at the age of five and was educated in Detroit schools. She was graduated from Detroit Business University 12 years ago and has worked as a secretary for eight of the intervening years.

Mrs. Stander enjoys water-color painting which she has pursued for the past two years without instruction. She has sold some of her fabric and wallpaper designs and the fruits of her hobby are evident in some of today's fashion motifs.

Golf Tournament Highlights Outing

Toledo, Ohio—A golf tournament with 70 participants opened Toledo Chapter's Annual June Frolic, June 12, at the Highland Meadows Golf Club.

After the tournament, dinner was served to 170 members and friends, followed by the awarding of golfing and door prizes. During the evening an acrobatic dancer, a dancing roller skater and an impersonator entertained, assisted by tool engineer talent.

The event concluded the season's program. Meetings will be resumed in September.

Stag Party

Moline, Ill.—Tri-Cities Chapter held its Annual Stag June 21 at the 40-8 Club on the Rock River, south of Moline.

Smorgasbord was enjoyed, and sports films were shown. The program also included group singing.

Program Personalities

Harry Coopland, Special Representative for Jack & Heintz, Inc., Cleveland, Ohio, is among the speakers available, upon advance request, to all Chapters of ASTE. During the fall and winter season, Mr. Coopland will deliver his popular address, "Seeing Is Believing."

Harry Coopland

A forceful speaker, Mr. Coopland is familiar to audiences in many cities for his enthusiastic, inspirational talks. In his current lecture, he demonstrates the practicability of the Golden Rule in business and industry, as practiced in the widely-publicized Jack & Heintz plant.

Mr. Coopland takes his listeners on an imaginary tour of the house that considers its employees "associates," pays high wages, uses no time clocks, and furnishes a multitude of free services, ranging from lunches to medical attention, at a cost of more than $100 per associate per month.

In return, the company enjoys the complete confidence and co-operation of its associates, who enabled Jahco to turn out a stupendous production of war goods at lowered costs.

The discussion is pleasantly interspersed with pertinent anecdotes which keep the audience demanding more. The speaker's dynamic personality has been cultivated through previous public relations contacts as Chief Steward on various ocean liners, caterer, hotel manager and campaign promoter.

Requests for Mr. Coopland's presentation should be addressed to: Harry Coopland, "Willow Lodge," RFD No. 1, Painesville, Ohio.

* * *

"Post-War Tool Steel" is the subject which Adolph J. Scheid, Jr., Chief Metallurgist of Columbia Tool Steel Co., Chicago Heights, Ill., has prepared for presentation before ASTE groups.

Mr. Scheid, in his talk, presents the production-cost problem and describes war-born techniques in handling and selecting tool steels. He comments on tungsten high speed vs. molybdenum high speed steel; new testing techniques, such as the Jominy hardenability test and the interpretation of "S" curves, including martempering.

Tool steels he briefly classifies, emphasizing the outstanding properties of each steel. Atmosphere control and double tempering are also discussed.

A. J. Scheid, Jr.

As illustration for the lecture, Mr. Scheid shows a 16mm color film, "Manufacturing of Tool Steel," and slides.

A graduate Metallurgical Engineer of the Minnesota School of Mines, Mr. Scheid has been associated with the Columbia Tool Steel Co. in various capacities since 1924. His technical society affiliations include ASM and AIME.

Mr. Scheid can accept invitations to address ASTE Chapters in Ohio, Illinois, Michigan and Wisconsin; Buffalo, N. Y.; Cedar Rapids, Iowa; Erie, Pa.; St. Louis, Mo.; Fort Wayne and South Bend, Ind.; Worcester, Mass.; and Minneapolis, Minn.

Arrangements should be made with R. M. Sandberg, General Manager, Columbia Tool Steel Co., Chicago Heights, Ill.

First Annual Field Day Features Varied Events

St. Catharines, Ont.—Fanned by cooling breezes from Lake Ontario, over 100 members and guests enjoyed the Niagara District Chapter's first annual field day at the Royal Niagara Golf Club on June 22.

Sports enthusiasts labored through a day-long program of games, including golf, baseball and horseshoe pitching, topped off with an appetizing dinner.

Past Chairman Joseph Little presented prizes to the winners of the various events, and Otto McIntee led the group in some rousing singing.

Arrangements for the outing were handled by Fred Dunn, Program Chairman, and his committee.

"Alloys and Their Uses" Topic of Joint Discourse

New York City—Technical session at Greater New York Chapter's May 13 meeting in the Hotel New Yorker featured two speakers from the Cerro de Pasco Copper Corp.

J. D. Trethaway, of the New York office, discussed bismuth and cerro alloys and their applications. His talk was followed with a lecture by W. C. Smith, Chief Metallurgist, who explained various applications of these alloys in dies, jigs and fixtures. Mr. Smith used slides to illustrate his address.

Chairman Holbrook Horton announced that Cortland Rhodes and Jack Schiller had been chosen Chapter delegates to the new Engineering Council of New York.

John J. Hogan, representative to the ASTE House of Delegates, described to the members the recent show and convention at Cleveland.

Builders of A. S. T. E.

James R. Weaver, President, 1939-40

By O. B. JONES, *Society Historian*

JAMES R. WEAVER became the eighth president of the American Society of Tool Engineers in March of 1939 when he was Director of Equipment, Inspection and Tests at the East Pittsburgh Works of the then Westinghouse Electric & Mfg. Co.

O. B. Jones

During his administration, he had able assistants in A. H. d'Arcambal as First Vice-President, E. W. Dickett, Second Vice-President; Frank R. Crone, Treasurer; and Floyd W. Eaton, Secretary.

I've often wished that your Historian were a man like Weaver (or any other good executive) who has the ability to organize the efforts of others so that he himself has time to supervise. (Jim now manages the Westinghouse East Springfield, Mass., Division).

No Wealthy Recluse

I suppose a historian should be a scholarly recluse with scads of money and a broken back. Give your Historian another fifty years and he'll be a Wow. Right now he's that little scratching sound you hear down under that pile of papers—mostly bills and government forms.

Strikes notwithstanding, Jim has written, in the following paragraphs, his own story of his year in the presidency, so maybe your Historian *is* an executive. He has organized his job so that others do it.

* * *

"In the midst of our second Machine and Tool Progress Exhibition, held at Detroit, I was elected President of the American Society of Tool Engineers," Jim begins. "This show was an overwhelming success, particularly in view of the newness of the venture and because it featured accessories to machine tools primarily.

"It had been realized by the Board of Directors and the Executive Committee of ASTE that there was a missing link in presenting new developments of interest to tool engineers and production technicians.

Show Valuable to Industry

"Tool engineers are responsible for installing machine tools and supplying the necessary accessories for industrial production of the highest quality and quantity. The Machine and Tool Progress show demonstrated that a great deal of information in these fields could be brought to members of the Society and to others.

"One of my first duties as President was to organize National Committees for the proper functioning of the Society which now included Chapters in many cities throughout the industrial sections of the United States.

"It was considered advisable that the various Chapters have more representation on National Committees. Two purposes were served in appointing these representative committees: 1. To obtain at National Headquarters the thinking of the various Chapters and areas; 2. To provide a means of carrying ASTE's aims to industry.

"We also recognized that the Society must grow. Therefore, particular emphasis was placed on the Membership Committee. We wanted to build the Society as rapidly as we could. However, we needed assurance that only qualified tool engineers would be admitted. A plan was developed to thoroughly analyze every application while, at the same time, a program was set up to attract legitimate tool engineers to join.

Chapters Compete for Trophy

"Contests were developed among the Chapters by offering a cup to the Chapter showing the greatest increase in membership during the year. This trophy is still being awarded for the best annual Chapter membership record.

"Membership services were increased by collecting more data on tools and accessories and distributing it widely. Another addition which aroused considerable interest was the appointment of an Education Committee. We knew that there would be great demand for tool engineers and that some training plan was necessary. Few schools, at that time, had even considered this type of training.

"The Education Committee was asked to develop a program and discuss it with schools on a national scale. The reception, at first, wasn't very encouraging. However, the Committee has persevered to the extent that the tool engineering profession is now recognized in a constantly-increasing number of schools, colleges and universities. Those early efforts have also borne fruit in the extensive program, with its many ramifications, recently launched by the Education Committee.

J. R. Weaver

"It is interesting to note that tool engineers have always advocated some sort of mechanical training in high school. Unless they contemplate continuing their education in college, high school graduates, as such, are very much at a disadvantage. A relatively small percentage go on to institutions of higher learning, most graduates entering business or industry after finishing high school. Generally speaking, high schools do not give a graduate sufficient background or knowledge to fit him for any kind of position in industry.

Makes Employment Study

"During my term in office, a Fact-Finding Committee was appointed, under the chairmanship of the late Professor John W. Younger of Ohio State University, to analyze the effects of technological improvements on business and employment. This Committee's survey resulted in some interesting conclusions that were quite advantageous.

"The Machine and Tool Progress Exhibition and the work of the National Committees, we found, contributed to the growth of the Society. Requests were received to organize Chapters in Los Angeles and San Francisco, Calif.; Toronto, Ont.; and Houston, Tex. Here was a spread clear across the United States and into another country. We could truthfully say that we were becoming an international society.

"While these Chapters were being set up, groundwork for other Chapters was being laid in South Bend, Ind.; Peoria, Ill.; and Springfield, Mass. These, too, were chartered during my administration.

Industry Co-operates

"We went to Cleveland in the fall of 1939 for the Semi-Annual Meeting—a program of technical discussions and a meeting of the Board of Directors. Again industry recognized that contributions through technical papers were most helpful in solving manufacturing problems. The attendance was excellent and exhibited unusual interest in the papers presented.

"The Society was now beginning to have growing pains. Many of the By-Laws and Rules and Regulations were, apparently, outmoded or misinterpreted. So it was suggested that the Past Presidents be appointed to interpret the Constitution, By-Laws, and Rules and Regulations. Since they had been parties to the adoption of the legislation, the former Presidents were in an excellent position to make interpretations during the study of the Society's law.

"New York City was the scene of the Annual Meeting in 1940. This time there was no show, it having been decided to hold the Machine and Tool Progress Exhibition every other year. Hotel New Yorker, the convention headquarters, had difficulty handling the large number of people present for the technical sessions and banquet. Again, the papers read were so remarkable that top leaders of industry became increasingly interested in ASTE, some of them participating in the New York meeting.

Promotes New Profession

"The American Society of Tool Engineers had developed a new profession in the industrial world. Prior to the time of the formation of the Society, very little thought was given to the men who developed the manufacturing facilities which have made the United States the industrial leader of the world.

"It was through this organization of tool engineers throughout the country that we were able to disseminate information and take full advantage of daily developments in industry. Had it not been for this organization, our country's effort in the production of materiel for World War II could not have been as effective.

"It was an extreme pleasure for me to serve as President of ASTE. I hope that I have made some contribution to the Society—I know that I have gained greatly in experience by being associated with the many outstanding men with whom I came in contact during my term of office. I particularly want to pay tribute to the tool engineers in the Detroit area, especially those men who had the vision to found this Society. It's a good example of how they work, and a true indication of why Detroit is the leading industrial city of the United States."

Boston Group Enjoys Variety of Sports at Annual Outing

1. Boston Chapter members and their guests engage in tug of war to work up appetite for picnic repast spread on tables at left, during June 8 outing at the Tyngsboro Country Club, Lowell, Mass. 2. A. J. Leone, Treasurer; H. J. Richards, Past Chairman; and J. B. Savits, Chairman, have respite from official duties. 3 and 4. Two groups of golfers relax in shady nooks on the course. 5. Participation in the pipe race demands concentration. 6. Larry Agnew and Ray Witham, General Electric Co.; Art Towse, Robert E. Morris Co.; and Walt Perkins, Reid Bros. Co., pause in their game to oblige Snapshooter W. W. Young, ASTE National Director and Boston Chapter member, who took this series of photos. The all-day outing also included horseshoes, shuffleboard, softball and several races. Prizes were awarded for the various contests. Dinner was served on the greens, followed by vaudeville in the clubhouse. Entertainment Chairman Bob Powell was in charge of the successful event attended by 150 ASTE'ers and their friends.

Airborne Rockets Pierce 6000 psi Concrete

Los Angeles, Calif.—Conway W. Snyder, Physicist at California Institute of Technology, made a return appearance before Los Angeles Chapter, June 13, following up his original talk on Atomic Power with an address on Rockets.

Mr. Snyder was recently awarded one of five scholarships established for postgraduate work in nuclear physics at "Caltec," foremost wartime producer of military rockets.

As rockets had not been used for military purposes since the War of 1812, Mr. Snyder explained, it was necessary to begin work from scratch. The first such weapon developed from this research was the 4½" barrage rocket weighing 20 lbs. Launched from a simple trough-like device, this rocket was useful in jungle fighting where it substituted for artillery. Although less accurate than heavy cannon, the light projectile could be brought into action where the former could not be used.

Effective Against Submarines

One of the most important anti-submarine weapons employed in the Battle of the Atlantic, the speaker revealed, was a 3¼" rocket consisting of a long tube, a motor and a solid steel head. By making two 3½" holes in its passage through the hull, this type of rocket was responsible for sinking many a submarine, he continued.

Among the rockets which Mr. Snyder showed and explained to his audience was the 5" spinner, developed late in 1944 and first used at Okinawa. Its stability in flight is obtained from rotation about its axis, rather than from fins. A group of jets, set at an angle at the tail of the motor, cause the escaping gases to exert a twisting in addition to the thrusting force.

These missiles, Mr. Snyder related, were fired in great numbers from all classes of vessels and vehicles. For a few seconds, they permitted an LST to bombard a hostile beach with fire power equal to a battleship's. So destructive and demoralizing was this offensive, that the enemy retreated from the onslaught, delaying action until he was out of range.

Foil-Filled Rockets Trick Enemy

More spectacular rockets, Mr. Snyder pointed out, were used by aircraft. During U. S. landings in Normandy, "Operation Window" completely disorganized the enemy's radar. Rockets of comparatively long range were shot over beaches where no landings were scheduled. When the motors had burned out, the rocket heads exploded, showering strips of aluminum foil in the air. These bits of metal were picked up by enemy radar, showing up on their scopes like fleets of airplanes. Through this ruse, much of the enemy's defensive power was diverted.

Originally designed for the Navy, the 5" aircraft rocket, the speaker said, was also widely used by the Army. In the break-through to St. Lo, it made a tank destroyer of every fighter plane. Largely developed by Mr. Snyder, who named it "Holy Moses," the rocket was effectively used against pillboxes, locomotives and ships.

When an artillery shell hits the water, he observed, it immediately begins to tumble and become deflected from its course; but, a rocket, due to its great length in proportion to its diameter, continues on its course close to the surface until its motive power is spent. Thus, a rocket correctly aimed at a ship is a sure hit whether it strikes the vessel itself or lights upon the water as much as 1000 feet short of the mark.

The rocket may be equipped with a delayed action fuse, causing it to detonate .002 seconds after it hits the target, or it may be fitted with a smoke head and used to lay a smoke screen. Its versatility in specialized applications make this rocket a most valuable weapon, Mr. Snyder emphasized.

"Tiny Tim," a rocket 12" in diameter and approximately 9' in length, the speaker introduced as "big brother" to "Holy Moses." This airborne artillery can drill a 24" hole through 6000 psi concrete. With photographs, Mr. Snyder demonstrated how such a rocket, with inert head, is capable of piercing two successive concrete walls, deflecting slightly upward after emerging from the first one; also how the same type of rocket, equipped with delayed-action fuse, can be exploded between the walls.

Concluding the talk that had held his nearly 300 listeners fascinated, Mr. Snyder commented on V-2's, long distance rockets and interstellar travel.

Starrett Company Host For Tour, Entertainment

Worcester, Mass.—A visit to the L. S. Starrett plant in Athol and an evening's entertainment by Arthur Starrett, company President, was enjoyed June 4 by 156 members and guests of Worcester Chapter.

Arthur Starrett

After an interesting trip through the plant in the afternoon, dinner was served at Hotel Peqoig, followed by a business session.

At its conclusion, Chairman Albert Warman turned the meeting over to Mr. Starrett who, with Dr. Henry Gerald, "The Mental Wizard of Denmark," mystified the audience with mental telepathy and psychological magic.

Guests included Third Vice-President Irwin F. Holland, National Treasurer Victor Ericson and Past President Ray H. Morris who spoke briefly during the business meeting.

Finney Sees Good Business Ahead in Metal Working

Hartford, Conn. — Burnham Finney, Editor of *American Machinist*, enlightened approximately 350 members and guests of Hartford Chapter on "What's Ahead in Metal Working," at the Annual Hartford Night dinner meeting held June 11 in Hotel Bond.

Two years of good business, he anticipates, will be enjoyed before present shortages are relieved. Postwar reconversion, he said, has been effected more rapidly than expected, with industrial operations now at the 1941 level and steel still the outstanding material.

Government plants are now being sold for 70% of cost, he continued, and manpower is only 66% of current needs, but, in some plants manpower efficiency curves have risen.

Russia, whose steel production capacity is only one-quarter of ours, represents a big market for goods, Mr. Finney believes. British competition will be the stiffest, because English manufacturers secure better teamwork and co-operation than American industry.

It is imperative, Mr. Finney stressed, that workers benefit from improved mechanical devices.

Commenting on the Society, he said that its rapid and widespread growth should be an inspiration to other societies. *The Tool Engineer*, official ASTE publication, he rated as one of the best contemporary professional magazines.

After opening the meeting, Chairman Edmond Morancey introduced Past President C. V. Briner who served as Toastmaster.

President A. M. Sargent also spoke, describing the revamping of organizational operations to conform with the Society's growth and position in industry.

Entertainment completed the evening's program.

Guests included Clayton R. Burt, Chairman of the Board, and C. W. Deeds, President and General Manager, Niles-Bement-Pond Co.; A. C. Fuller, Chairman of the Board, Fuller Brush Co., and President, Connecticut Mfrs. Association; H. Mansfield Horner, President, United Aircraft Corp.; William Fenn, Sr., President, Fenn Mfg. Co.; Sidney E. Cornelius, Vice-President, Hartford County Mfrs. Association; V. H. Ericson, ASTE National Treasurer; F. W. Curtis, W. W. Young and E. J. Berry, National Directors of ASTE.

Spurs Tool Engineers To Greater Feats

San Francisco, Calif.—"The magnificent contribution of the tool engineer to our wartime economy will be surpassed in the years immediately before us," Past Chairman Walter Kassebohm predicted in a thought-provoking address before the 85 members of Golden Gate Chapter and their wives who attended the Annual Dinner Dance, June 18, at the City Club Hotel, Oakland.

Walter Kassebohm

Continuing his talk on current economic trends and their influence upon professional tool engineering, Mr. Kasselbohm warned his listeners that they must do their own thinking on the political economic problems with which the nation is beset.

During the evening Chairman Edward J. Raves introduced to the gathering the various committee chairmen, explaining their respective functions.

Homer Cockrille and his orchestra provided music for the enjoyable affair.

Jeweler Shows Collection Explains Gem Cutting

San Diego, Calif.—Taking his listeners back through the ages, Arthur Jessop of the famed Jessop firm of jewelers, narrated for members and guests of San Diego Chapter the romance and development of diamonds and many other precious and semi-precious stones.

Mr. Jessop was the speaker at a recent dinner meeting held in Cafe Orlanna, the new Chapter meeting place.

His description of the tooling involved in the cutting and polishing of stones and in the manufacture of rings and other settings was instructive and thought provoking.

Mr. Jessop graciously permitted the members to closely examine a valuable collection of jewelry, to better demonstrate the high type of artistry and engineering employed.

Coopland to Address 'Past Chairmen's Night'

Boston, Mass.—A program honoring Past Chairmen will open Boston Chapter's fall season on September 12.

Harry Coopland, Special Representative of Jack and Heintz, Inc., Cleveland, Ohio, will be the principal speaker. His subject will be "Seeing Is Believing," an exposition on the practicability of the Golden Rule in business and industry.

A "gadget talk" and a new 10-minute feature consisting of "How to Do It" slides will be included in the program. The Education Committee will provide a display of technical magazine reprints. A "quiz" question will be propounded in the September bulletin (and each subsequent issue) for solution from the floor.

The meeting is scheduled for 6:30 P.M. at Schrafft's Restaurant.

Some 350 Chapter members, local industrialists and ASTE National Officers attended the Annual Hartford Night dinner, June 11, at Hotel Bond, Hartford, Conn. Burnham Finney, Editor, American Machinist, delivered principal address of the evening, "What's Ahead in Metal Working." Seated at speakers' table (left to right) are: Clayton Parsons, Chapter Treasurer; E. J. Berry, National Director; Ray H. Morris, Past President; Sidney E. Cornelius, Vice-President, Hartford County Mfrs. Association; William Jarvis, Chapter Second Vice-Chairman; William Fenn, Sr., President, Fenn Mfg. Co.; H. Mansfield Horner, President, United Aircraft Corp.; Irwin F. Holland, ASTE Third Vice-President; C. W. Deeds, President and General Manager, Niles-Bement-Pond Co.; A. M. Sargent, ASTE President; Edmond Morancey, Chapter Chairman; C. V. Briner, ASTE Past President; Mr. Finney; V. H. Ericson, ASTE National Treasurer; Clayton R. Burt, Chairman of Board, Niles-Bement-Pond Co.; A. C. Fuller, Chairman of Board, Fuller Brush Co., and President, Connecticut Mfrs. Association; A. H. d'Arcambal, ASTE Past President; Donald Finke, Works Manager, Rhodes Mfg. Co.; Richard A. Smith, Chapter First Vice-Chairman; and O. Robert Edmonds, Chapter Secretary. Other speakers included Mr. Sargent and Mr. Briner who officiated as toastmaster.

Obituaries–

James E. Kearsley

Succumbing to an illness of more than a year, James E. Kearsley, 59, of the Safety Car Heating and Lighting Co., New Haven, Conn., passed away recently at his home in Hamden, Conn.

J. E. Kearsley

Born in Liverpool, England, he attended the Salford Technical High School and was apprenticed at the General Electric Works at Salford, England. As a young man he left England for Canada, subsequently going to Detroit where he was employed by Dodge Brothers, and later to Westinghouse at Pittsburgh until June of 1907, when he received an appointment by the Isthmian Canal Commission.

The following year he began a two-year stay in England, returning to the United States in 1910 to enter the employ of the Edison Storage Battery Co. as Assistant Foreman of the Tool Room.

In 1912 he began his association with the Safety Car Heating and Lighting Co. at their factory at Jersey City, N. J., as Foreman of the Tool Room. In 1918 he was appointed Mechanical Supervisor and went to New Haven when the company moved to that location. At the time of his death, Mr. Kearsley had charge of the design and building of all tools used at the factory and of manufacturing methods.

During the war his skill in designing tools aided the company to produce fire control instruments to the precision required by the Ordnance Department.

Mr. Kearsley was a member of New Haven Chapter, ASTE, and of Day Spring Lodge, A. F. & A. M.

* * *

William J. McKeen

William J. McKeen, partner in McKeen and Stoothoff, Ridgewood, N. J., passed away, June 12, at his home in Glenrock, N. J., after a short illness.

W. J. McKeen

A native of Leith, Ont., where he attended the public schools, Mr. McKeen became a United States citizen after entering this country in 1929. His technical training was acquired through a five-year ICS course in Mechanical Engineering.

Coming to Detroit, he became associated with Packard Motor Car Co. as a tool designer, later serving a number of years with Pioneer Engineering & Mfg. Co., before going to New Jersey to establish his own engineering business.

It was during his stay in Detroit that he was invited to join the group that subsequently founded the American Society of Tool Engineers.

Inspired by the bright prospects of an organization destined to elevate the profession of tool engineering to its rightful place, Mr. McKeen conceived the idea for the sunburst design which is now recognized everywhere as the official ASTE emblem.

The story of the origin and development of this symbol was related in the *ASTE News* section of the December, 1945, *Tool Engineer*.

At the time of his death, Mr. McKeen was affiliated with Northern New Jersey Chapter, ASTE, and was an F. & A. M. Mason.

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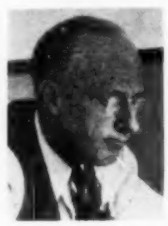
Eugene J. Chally

Eugene J. Chally, 48, employed by the Ramsey Corp. of St. Louis as Tool Designer, died April 24 after being stricken with a heart attack.



E. J. Chally

Born in St. Louis, Mr. Chally received his education in the public schools of that city. His whole career was centered around tool designing, beginning with his apprenticeship at the Century Electric Co. Later he worked for the Wagner Electric Co., the Scott Newcomb, Inc., and the Ramsey Corp., always at the designing of tools.

A member of St. Louis Chapter, ASTE, Mr. Chally was also affiliated with fraternal organizations.

* * *

William Ehrhardt

William Ehrhardt, 54, Supervisor of Tool Room and Machine Repair, Wright Aeronautical Corp., Paterson, N. J., recently succumbed to a lingering illness of about a year and a half.

William Ehrhardt

Mr. Ehrhardt served his apprenticeship in his native Germany, coming to the United States at the age of 22.

After working in various machine shops and tool rooms, he became associated with the Simplex Cloth Cutting Machine Co., New York, joining the Wright Co. in 1923.

There he became a tool follow-up man, successively advancing to Assistant Foreman and Foreman of the Tool Room, and finally to the position he held at the time of his death.

Mr. Ehrhardt was a member of Northern New Jersey Chapter, ASTE, and of the Wright Aeronautical Supervisory Council.

* * *

Thomas F. Lacey

Thomas F. Lacey, Quarterman Machinist at the Naval Torpedo Station, Alexandria, Va., died suddenly from a heart attack suffered recently.

Born in Homestead, Pa., in 1893, Mr. Lacey spent the greater part of his life there, moving to Washington in 1934.

At the Naval Torpedo Station, he had charge of the Assembly Division Tool Crib and the purchase of all tools and equipment for the Assembly Division.

Previously he had been employed at the Washington Navy Yard for seven years and at the Homestead Steel Works, Homestead, Pa., for approximately 23 years, serving his apprenticeship at the Mefta Machine Co., West Homestead, Pa.

He received his technical training at Carnegie Institute of Technology, Pittsburgh, Pa.

A very active member of Potomac Chapter, ASTE, Mr. Lacey was Editorial Chairman at the time of his death.

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Lester R. Chapin

Lester R. Chapin, 48, Tool Crib Foreman for Eversharp, Inc., Chicago, died May 23, following an illness of pneumonia.

Mr. Chapin had been employed by the Eversharp company since 1942. Earlier he served as Supervisor of Educational Work at the Uhlich Home and as Foreman at Clayton Mfg. Co.

He was a member of Chicago Chapter, ASTE.

Healy Advanced To Chairmanship

Portland, Ore.—G. E. Healy, of Portland Gas & Coke Co., is the 1946-47 Chairman elected by Portland Chapter, succeeding Ray Neils of the Schmitt Steel Co. Mr. Healy held a vice-chairmanship during 1945-46.

G. E. Healy

Other officers elected are: W. E. Brennan of the Iron Fireman Mfg. Co., First Vice-Chairman; N. B. Williamson of Jarman-Williamson Co., Second Vice-Chairman; and W. J. Brandenburg of Hyster Co., Treasurer. J. R. Barrett, of Moore Dry Kiln Co., was reelected Secretary.

Committee Chairmen are: D. A. Morand, Constitution and By-Laws; Eugene Butzer, Editorial; C. J. Sharkey, Membership; Earl F. Winkler, Industrial Relations; W. A. Bristow, Standards; W. E. Brennan, Program; Ray Neils, Public Relations; J. C. Othus, Education; N. B. Williamson, Entertainment; and Richard Brenneke, Hospitality.

Instrument Society To Sponsor Show

Pittsburgh, Pa.—An "Instrumentation for Tomorrow" Exhibit will be presented by The Instrument Society of America, September 16-20, at the William Penn Hotel, Pittsburgh. The Show will be held concurrently with the Society Conference.

The Exhibit will feature the latest developments in industrial and scientific instruments for research, analysis, measurement, control, inspection and testing; and the multitude of devices, products and materials of the industries serving the instrument business.

In addition to the daily technical meetings to be held in conjunction with the Conference, "short courses" will be conducted at the Carnegie Institute of Technology under the direction of Dr. B. R. Teare, Jr., Head of the Electrical Engineering Dept. at Carnegie and Chairman of the Society Educational Committee.

During the same week, the Instruments and Regulators Committee of ASME will also meet in Pittsburgh.

Handbook to Be Invaluable Aid in New Production Economy

HIGH LABOR and material costs, a shorter work week, foreign postwar competition already established and flourishing, and depleted natural resources necessitating substitute and synthetic materials all combine to make the tool engineer the key man in industry.

In order to shoulder this responsibility and maintain his splendid record of wartime achievement, the tool engineer must be a fount of production knowledge. Wherever he makes or influences a decision, the "Tool Engineers' Handbook" will be an indispensable aid.

Representing the composite experience of several hundred outstanding engineers, metallurgists, chemists, scientists, researchers and editors, the forthcoming ASTE manual will contain information vitally-needed by today's production expert—whether he is investigating new materials and methods . . . doing original research . . . analyzing setups and operations . . . improving and standardizing planning and control . . . or designing products or tools.

Visual Material

Much of the accumulated knowledge contained in the new reference work may be visually ascertained through carefully prepared and selected charts, tables, graphs and drawings, augmenting the text.

Fingertip control of this wealth of engineering data will be provided in a comprehensive cross-index of some 14,000 entries.

In addition to previously announced editorial contributors, the Handbook Committee and Editor Frank W. Wilson have secured the co-operation of:

W. H. Oldacre, President and General Manager, D. A. Stuart Oil Co., Chicago, Ill., the organization with which he has been associated for more than a quarter of a century.

W. H. Oldacre

Because of the specialized interests of his company, Mr. Oldacre has given much attention to metal cutting problems and to sulphurized and sulphochlorinated oils and greases. For a number of years, before assuming his present duties, he was Director of Research. He was first introduced to the oil business as a safety engineer with the Timken Roller Bearing Co. of Canton, Ohio.

Well-Known Lecturer

A familiar platform figure, Mr. Oldacre frequently appears before Chapters of ASTE and other engineering societies. A number of his addresses have been published in trade journals. His lecture, "What the Tool Engineer Should Know About Cutting Fluids," delivered before the recent ASTE Annual Meeting in Cleveland, was one of the papers comprising the Cutting Fluid Symposium in the July *Tool Engineer.*

Various fields of technical education and research command his interest. A member of the Board of Trustees of Hiram College, his alma mater, he serves on the Board of Directors of the National Lubricating Grease Institute of which he is a Past President. He holds offices in the local Chapters of SAE and ASME and participates in the work of other national technical societies such as ASTM, ASM, API, ACS, and AISE.

During the war he was active in the Gear Oil Projects in connection with the Co-ordinating Research Council, an organization actively assisting the armed services in the solution of wartime lubricant problems. At present he is a member of the Council's Steering and Advisory Groups.

Mr. Oldacre has also won wide recognition through his work with the Independent Research Committee on Cutting Fluids.

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A "Connecticut Yankee," **J. Robert Moore**, Secretary, Moore Special Tool Co., Bridgeport, returned to his native state after graduating from Mt. Herman School, and Clark University, Worcester, Mass.

For ten years he gained industrial experience as a toolmaker, designer and sales engineer before becoming Factory Manager of the Jig Borer Division of the Moore Company, in 1937. He is co-designer of the jig borer, jig grinder and panto-crush wheel dresser manufactured by his company.

J. R. Moore

H. E. Rockefeller

Despite extra-curricular duties as instructor at Bridgeport Engineering Institute, Mr. Moore finds time to address eastern Chapters of ASTE where he is popular for his talks on High Precision Machine Tools.

Another of his avocations is contributing technical articles to leading trade publications. Recently, he completed a 425-page book, "Precision Hole Location for Interchangeability in Toolmaking and Production."

Mr. Moore is a member of Fairfield County Chapter, ASTE, and the Bridgeport Tool Engineers' Association.

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H. E. Rockefeller, Manager, Process Development Dept., The Linde Air Products Co., New York City, began his association with this company in 1922, a few weeks after obtaining his B.S. in Mechanical Engineering from Massachusetts Institute of Technology. Eight years later he assumed his present position.

He is affiliated with the American Welding Society, International Acetylene Association and the American Society of Mechanical Engineers.

* * *

The Detroit automotive industry had provided a substantial tool engineering background for **Carl J. Oxford** when he joined the National Twist Drill & Tool Co., Rochester, Mich., as Chief Engineer, nearly two decades ago.

He, in turn, had contributed to the evolution of motor vehicle manufacturing to a mass production business, through his association with Packard, Dodge, and Nordyke & Marmon.

Among his present responsibilities as head of the company's engineering activities, is the editing of National Twist Drill & Tool engineering bulletins. His success in this work led to his recent appointment in a similar capacity on a sub-committee of the ASTE National Standards Committee. He also serves on technical committees of ASME and ASA.

C. J. Oxford

Mr. Oxford has read papers on Metal Cutting, at the invitation of ASME and SAE, and over a period of years, has addressed many Chapters of ASTE and ASM, both in this country and Canada.

After spending his childhood in his native Norway, the future engineer emigrated to this country, receiving his high schooling in Detroit and his mechanical engineering training at the University of Michigan.

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Through active participation in the technical programs of several engineering societies and other organizations, **Arthur N. Kugler**, Mechanical Engineer in the Technical Sales Div. of Air Reduction Sales Co., New York City, cooperates in advancing the engineering profession by interchange of information and experience.

Writes for Welding Handbook

Presently he is working on six of the committees preparing chapters for the second edition of the AWS Welding Handbook. In addition he is a member of AWS committees studying Minimum Requirements for Training Welding Operators, Safety Code for Arc Welding and Oxyacetylene Welding and Cutting, Investigation of Deep Fillet Welding Technique, and Standard Qualification Procedure.

Other committee activities include: Safety Code for Construction Industry, ASA; Tests for the Selection of Welding Operators, and Oxyacetylene, International Acetylene Association; and editorial preparation of the Pipe Welding Manual of the Heating, Piping & Air Conditioning Contractors National Association.

Also affiliated with ASME and Greater New York Chapter, ASTE, he is licensed to practice Professional Engineering in the State of New York.

A. N. Kugler

In 17 years of service with Air Reduction, Mr. Kugler has specialized in the application of welding to various industries, particularly in the welding of piping for oil, gas, steam and water service. He has contributed to the development of multilayer oxyacetylene welding and oxyacetylene welding of carbon molybdenum steel pipe.

One of those rare persons, a native New Yorker, Mr. Kugler attended the schools of that city and received his M.E. at Stevens Institute of Technology.

Educators Hear Winter Discuss Society Aims

Fort Worth, Tex.—O. W. Winter, ASTE National Education Chairman, recently addressed a specially-arranged meeting of North Texas Chapter. The meeting, held at The White House, Fort Worth, was attended by several local educators.

O. W. Winter

Mr. Winter explained, to the 125 members and guests present, the educational aims of the Society to achieve national recognition for the profession of Tool Engineering.

He recounted the development of ASTE from its beginning in the depths of the last business depression to its present status as the second largest technical society in the United States.

Members, he asserted, should live up to their hard-earned place in the profession of engineering, to the end that educational institutions offering engineering courses will include in their curricula courses of study leading to degrees in Tool Engineering.

After Mr. Winter's talk, an informal discussion was held.

Guests at the meeting included: Dean C. K. Holsapple, Texas Christian University, Fort Worth; Dean E. H. Flath, Southern Methodist University, Dallas; G. B. Trimble, Director, Vocational Education, Technical High School; and D. D. Walden, Educational Director, Consolidated Vultee Aircraft Corp., Fort Worth.

GM Recognizes Production Men

Detroit, Mich.—The importance of the production expert in tomorrow's industry has been acknowledged by the country's largest corporation, *The Detroit News* points out in a recent editorial commenting on the administrative reorganization of General Motors.

The *News* says, in part, ". . . Coincident with GM President C. W. Wilson's appointment as chief executive officer, the GM administrative headquarters is being moved from New York to Detroit. . . .

"This event, of evidently great meaning to Detroit, has involved no shift in financial control of the corporation, of course. Alfred P. Sloan, Jr., remains as chairman of the board.

"But the changes involved, geographical and otherwise, are no less important for that. There is evident throughout the announced list of appointments of top personnel a shift in emphasis from the financial to the operational phase of the business.

"Beginning with Wilson himself, production men have been assigned the posts of highest responsibility, because—the conclusion seems evident—the keynote of the automotive future is production."

The *News* also refers to the $50,000,000 research laboratory to be built by Ford Motor Co. at Dearborn, Mich.

Both announcements by the big automotive leaders were made during "Jubilee Week" when Detroit observed the industry's 50th anniversary.

British Gauge and Tool Makers Hold First Exhibition ASTE'er Shows Company's Products

London, Eng.—First exhibition by the Gauge and Tool Makers' Association of England and first important postwar show to be presented by any British industry was recently held in New Hall, Vincent Square, London.

L. H. Rhodes, General Manager of S. Carlton Smith, Ltd., Dunstable, England, and one of ASTE's newer members, represented his company at their booth. The Smith company displayed special gauges, press tools, jigs and fixtures, and other precision tooling equipment.

Only tools actually made by the exhibitor and available for purchase could be displayed at the show. Although material shortages reduced the size of the exhibition, large orders were placed with the 86 firms participating.

On several days, attendance at the "key industry to key industries" show overflowed the capacity of the hall. Despite transportation difficulties, foreign buyers were well represented among the visitors.

Commenting on the display, Mr. Rhodes says, "An exhibit of this description is difficult from the exhibitor's viewpoint, as it is not possible to show a very large selection of tools unless they can be borrowed from customers. . . . However, for all that there were some very fine displays of tools and measuring instruments.

"We are now," he reports, "in the throes of rushing through tools for peacetime products. The types of tools we are asked to undertake for various products are as wide as the poles, but this of course is not unusual in the tooling industry. We trust that our friends in the States are also going full steam ahead on postwar production, and we wish them the best of luck for the future," Mr. Rhodes graciously concludes.

A frequent news correspondent of the *ASTE News* section of *The Tool Engineer,* Mr. Rhodes is making his first technical contribution in an illustrated article on British thread grinding, scheduled for publication in an early issue.

Credits Crush Forming To New England

Springfield, Mass.—"Crush Form Grinding Precision Contours" was thoroughly explained to more than 100 tool engineers attending a recent dinner meeting of Springfield Chapter.

The speaker was John C. Wilson, Chief Engineer and Sales Manager, The Thompson Grinder Co., Springfield, Ohio.

Tracing the origin of crush cutting grinding wheels to a New England concern, in the 19th century, Mr. Wilson stated that crushing grinding wheels is not a new process. Neither was it invented in Germany, as is popularly believed, he asserted, although the Germans did some of the early development work.

In a clear and concise manner, Mr. Wilson covered the method of forming by crush wheel grinding. At the close of his lecture, a film on Thompson Truforming was shown.

Following the motion picture, there was an extended question period which the speaker handled with ease and clarity.

Perfect Circle Company Entertains ASTE'ers

Richmond, Ind.—The Perfect Circle Piston Ring Co. of Hagerstown, Ind., played host to 108 members and guests of Richmond Chapter at their regular meeting, May 14.

The meeting was held in the plant cafeteria and was attended by several of the company officials.

Lee H. DeWald, formerly with Vascoloy-Ramet Corp. and now of Massachusetts Institute of Technology, was the speaker of the evening. His subject was "Powder Metallurgy and the Tool Engineer."

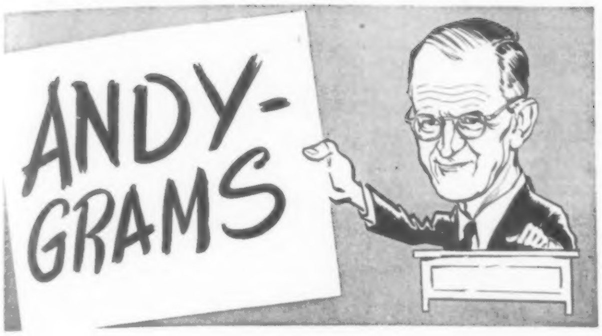
Contrary to popular opinion, he said, powder metallurgy is not a new art, but a very old one, dating back to antiquity. Lost for hundreds of years, the science of producing powdered metals was recovered in England in the latter part of the eighteenth century.

Mr. DeWald also showed a number of samples and a series of slides.

The Perfect Circle quartet, "The Hoosier Harmonizers," gave a group of old-time favorites in close harmony.

Among the special guests were the Rev. Gail Davis of the Hagerstown Methodist Church, Earl V. Johnson of Dayton, Ohio, ASTE Past National Secretary; and Howard McMillen, Chairman of the newly-chartered Evansville Chapter.

L. H. Rhodes, General Manager of S. Carlton Smith, Ltd., Precision Engineering Works, Dunstable, surveys his company's booth just before opening of first Exhibition of the Tool and Gauge Makers' Association recently held in London, England. Press tools, special gauges, jigs and fixtures were displayed in the Smith company's exhibit. Mr. Rhodes, a member of ASTE, is the author of an article on British thread grinding soon to appear in The Tool Engineer.



Mert Seavey, from out California way, wrote in to ask if I really meant "the public be pleased," as per my June comments. Sure I meant it! As for that, the majority of our readers declare themselves pleased with The Tool Engineer, and that's the public I'm working for. Of course, an occasional brickbat is tossed in along with the bouquets (we can't please everybody all of the time); however, a jacking up now and then tends to keep us in line.

Contributing authors, too, declare themselves pleased with our magazine; like the readers, they're all for concluding the articles in the editorial section instead of "scattering them all over the lot" in the back pages.

E. A. Cyrol of the Windy City (who has an article in this issue) called up to say that he is proud to be a contributor to The Tool Engineer. And Winston Prins, who will shortly come through with another interesting article, wrote in to say: "You manage to get out the book in remarkable fashion. No one would realize, on reading it, that you are only a yearling (as publishers), that you lost considerable time with the Cleveland (ASTE) Show and that you have recently moved your editorial offices . . . We are most pleased to have the article come out under your editorship."

Similar expressions have come from Fred Burt, now one of our "regulars," and from Walter Brooking (to whom you may look forward for an excellent article on welding procedures) and many other authoritative writers. This attitude is reflected in outstanding articles on the very things tool engineers want to know about. The value of these articles is indicated, not only by an inordinate demand for tear sheets and reprints, but by recurrent suggestions, from readers, for changes in makeup that will facilitate cutting out and filing.

Right now, we have a bank of articles that should put The Tool Engineer among the "best sellers" in the technical publications field. Included—and scheduled for an early issue—is an article on *Crush Form Thread Grinding*, by L. H. Rhodes of Dunstable, England, that will make mighty "good reading." The manuscript was prepared with such typical British thoroughness that the reading was a pleasure and the editing confined to adding a few notes that the author had modestly omitted. In addition, I'm looking forward to an article on jig boring, to unbelievably close tolerances, from Sweden.

Speaking of Sweden, I had a postcard from Director Larry Rademacher (postmarked Stockholm) in which he said that he'd gone over to find out what "makes me that way." Now Larry! If he'd told me of the impending trip I'd have put him in touch with a number of my *landsmen* who, of late, have evinced such an interest in the ASTE—and The Tool Engineer—that it wouldn't surprise me a bit to see our friends in the high North organize a Chapter. In this connection, an old friend and former ASTE'er—Ivar G. Eklund, formerly ch'f eng'r with Midland Steel Products Co.—is now managing director of Ljungman A/B, Malmo, one of Europe's most progressive manufacturing concerns.

Several readers have commented on the July Andygrams—or Andy*groans*, as the typesetter phrased it—one of them wanting to know my secret (?) of getting along with people. Well, I'm no authority on human relations, having been called everything from a bull in a china closet to a master diplomat in my time. (Prex Al Sargent dubbed me a perfectionist, whatever that is.) No, I'm like the preacher in the story who told his flock to "do as I say, not as I do." Personally, though, I've found that it's much easier—and far more pleasurable—to like people than to dislike them, and that the way to win loyalty is to show consideration for the rights of others.

Of course, one has to stick up for one's own rights, too, as I had to learn the hard way. When I first came to America, as a tad, I met a boy who put up his hands in a novel way and, thinking it was some kind of Yankee game, I did likewise. Then, he punched my nose! Next time, I got in the first sock without waiting to strike a pose and, learning new tricks as the corners rounded off, finally won my peace. In time, I found that the glad hand goes a lot farther than the clenched fist.

As aforesaid, we get occasional kicks along with the plaudits. One critic implied that some of our articles are "elementary"—he just wanted "advanced stuff"—and several have suggested that we exclude "ordinary tools" from our *Tools of Today* department and confine it entirely to outstanding developments. Well, now! As a Society and as a publication, we probably cover more territory than any contemporary (tool engineering is embracing and inclusive) and we cater alike to veterans in industry and to youngsters being trained to fill our shoes when we pass on to some Utopia where we won't be forever "in the middle."

Consequently, we balance "highbrow" stuff with *fundamentals* designed to initiate beginners into the know-how of making things. And often enough, these "elementary" subjects are just as new, and just as educational, to the veteran as they are to the tyros. It's like algebra, elementary to the Prof but ofttimes Greek—or Arabic, to credit the source—to the guy who hasn't mastered its intricacies.

As for the relative values of "Tools of Today," what differentiates the commonplace from the outstanding? Files and hacksaw blades may be considered ordinary tools—at least, they're taken for granted—but their manufacture is Big Business and if a novel development extends useful life manifold, then that's new and important to industry. In a sense, a new cutting tool may be considered more important than a new machine tool since the former forces the refinement of the machine which, in the final analysis, would be impotent without the cutter.

Well, so much for "shop" talk. When this issue goes to bed I'm hieing myself to the north woods for a well earned vacation—my first in years—there to try out a miscellany of antique firearms (if I can get the *ammo*) and to enjoy piscatorial diversion. No newspapers, no radio, no nuthin'—just the solitude of the wilderness and the sough of pines to lull me to sleep. I'll tell you all about it later.

Andy

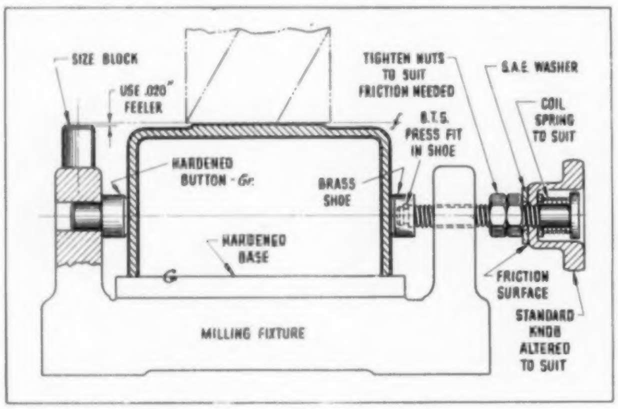
GADGETS

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Friction Clamp Screw*

Conventional clamping screws, when used to clamp thin wall castings—as in drilling or milling fixtures—have a tendency to distort the work when pressure is applied. With the friction clamp screw shown, the operation does not depend on "feel," since the right amount of pressure can be adjusted to suit.

Frank J. Peragine
Greater New York Chapter, ASTE



*For the benefit of those who may wish to use a device of this kind, commercial "Torque Thumb Screws" may now be had from Vlier Manufacturing Co., 4552 Beverly Blvd., Los Angeles 4. Literature is available.

The Editors

Transparent Machine Guards

As a safety precaution, drill press operators should be protected from flying chips. Ordinarily, operators are provided with goggles or head shields; however, there are disadvantages to these devices and constant supervision is required to enforce their use.

The plastic guard, illustrated, obviates the use of goggles and shields, insures full protection and greater operator comfort. Consequently, they have been enthusiastically accepted where used.

R. Gibbs
Westinghouse Electric Corporation
East Springfield, Mass.

Tapping Quadruple Threads

A new method of tapping has multiplied production and greatly decreased rejects in the production of the special bronze nut shown in Fig. 1. The nut is $\frac{3}{4}$" I.D., 1.120" O.D. x $1\frac{7}{8}$" long and has a quadruple 29° Acme thread of 1" lead and $\frac{1}{4}$" pitch. When the nut was first put into production, an attempt was made to chase the threads on a lathe with a single point cutting tool, but because of the percentage of scrap, a series of five taps were developed to cut the thread.

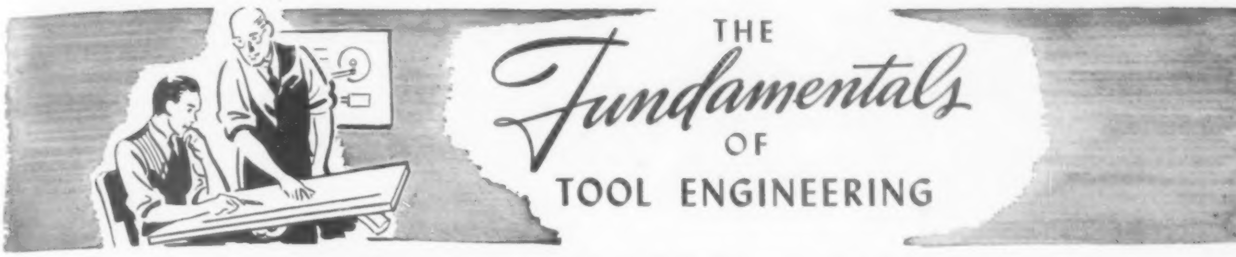
Following the old method, the steps in making the nuts are cut off, drill, face and thread. Instead of chasing the threads in a lathe, however, they are now tapped on a universal turret lathe in five steps. To facilitate finish tapping, the threads are tapped to $\frac{3}{4}$ of the full depth. The operator runs the taps into the nut and, as he removes each nut from the chuck, washes it in kerosene to remove the chips. There are notches on the shanks of the taps to aid the operator in using them in the proper sequence. Fig. 2 shows the operation.

The same method has been applied to a $\frac{5}{8}$"-$\frac{1}{2}$ double thread monel nut that could not be chased successfully with a single point tool.

Otto Starke, Factory Service Div'n
Westinghouse Electric Corp'n
East Pittsburgh, Pa.

FIG. 1 below.

FIG. 2 at right.



Drilling and Boring Tools*

Installment No. 1 of a Series

BECAUSE THE DRILLING of holes is one of the most common operations in manufacture, there is a widespread misconception regarding its importance to industry. It is considered by many to be "elementary," an assumption borne out by the fact that comparatively little skill is required to drill a hole in wood or metal. And, for ordinary work, the running of a drill press entails little if any preliminary training as compared to other machining operations. Yet, drilling is often but a preliminary step in the machining of holes, and with modern techniques, cutting tools and machines, and with modern practice in control of dimensional quality, which is so essential to interchangeable assembly, hole sizes and spacing between holes must be closely held. When all of these things—and many more—are taken into consideration, it will become apparent that the drilling, boring and finishing of holes creates problems that may well tax the ingenuity of even the most experienced Tool Engineer.

We do not know when man first began to drill holes, but certainly drilling antedates the early Stone Age. We may assume that it originated with the making of fire by means of the primitive fire drill, the most elementary of which was a stick twirled between the palms of the hands. One end was pressed against easily ignitable wood, the friction creating sufficient heat to start a blaze in the abraded particles. One may infer that, if the same block of wood were used recurrently, the repetitive "drilling" would eventually pierce the block.

Next, man learned to pierce objects with pointed stones or bones, much as one may gouge out a hole with the blade of a jackknife. Then, in the evolutionary course of toolmaking, came the bow drill (Fig. 1) which was used to twirl a stick to which was attached a bone or flint artifact. Since only one hand was required to manipulate the bow, the other could be used to exert pressure against the object being drilled. And that was the genesis of speeds and feeds in drilling.

By the time of the second dynasty in Egypt, drilling had developed to a point where beads of precious and semi-precious stones were being pierced. It is assumed that such drilling followed modern practice, as in diamond die making, of using a copper tool and hard, fine abrasive dust. At any rate, the required speed would be high and, as the bow drill was undoubtedly used, one may further assume a high degree of skill and sensitiveness on the part of the artisan.

Next, in the course of evolution, came the "drill press," which was the bow drill on a large scale. The spindle was a log, guided at its upper end by a ring held in a tripod. Later, the spindle was placed horizontally, from which developed the horizontal drill and the lathe. By that time, too, metal drills had come into use, presumably of copper or bronze although iron may have been used. The drills were flat.

The flat drill, in turn, evolved into the twist drill, which was merely the flat drill twisted into a helix. Rusted fragments of such drills, antedating the 10th century, have been unearthed in medieval ruins. In time, some genius applied a starting or lead screw, thereby creating the self-feeding wood bit. This, inserted in a cross bar to form a Tee, gave us the auger. Then came the bit brace, which has not appreciably altered during the centuries, except as it has been refined with improved chucks and ball bearing cranks and spindles.

It is possible, at this point, that some of our readers may consider the foregoing historical sketch entirely superfluous. "What has ancient history to do with modern tool engineering?", it may be asked. The answer to that hypothetical question would be: "Everything or nothing, depending on circumstances."

Consider, for example, the slow development of tools in past ages. While early man applied fundamentals and basic principles in the making of tools and utensils, he nevertheless failed to immediately build on the principles accidentally discovered. That is, he employed techniques — to use that term—the principles of which he but vaguely understood; he availed himself of fundamentals but failed to grasp their significance. As a result, material progress remained static for many thousands of years, with new developments coming in bursts much after the manner of flood waters long held in check.

A considerable part of the material, for this Series, is drawn from a paper by S. A. Oliver, Production Manager of Otis-Fensom Elevator Co., Ltd., Hamilton, Ont., presented at Hamilton Chapter, A.S.T.E.

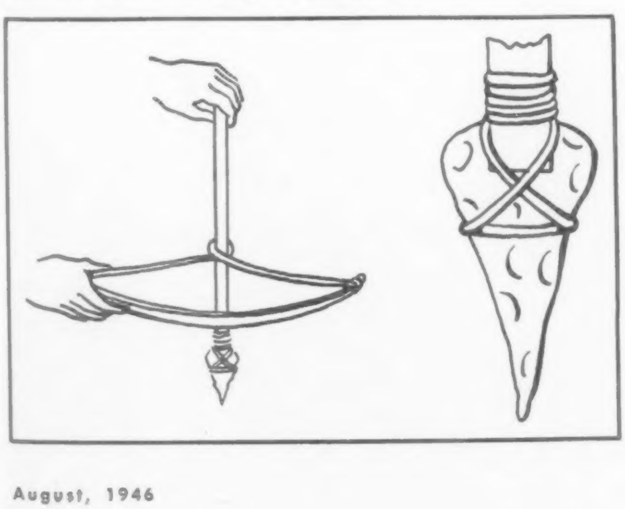
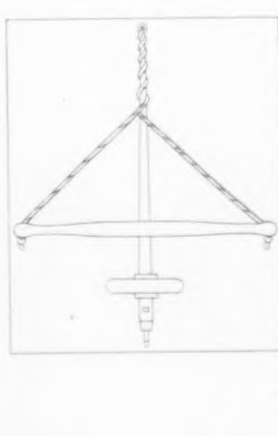


FIG. 1, left FIG. 2, below



Inversely, a grasp of fundamentals, on the part of modern man, has so accelerated progress that we have advanced more in the past one hundred years than in all of the previous ages combined. And as far as mechanical progress is concerned, it is mostly based on a few simple hand tools—the axe, hammer, saw and drill. And the latter, along with the potter's wheel—is the progenitor of the majority of modern machine tools.

A knowledge of fundamentals is essential to invention, and even to survival. A man grounded in fundamentals could effect his material salvation even though he were to find himself empty-handed in a wilderness. He could make cutting tools of bone, shells or stone (in a comparatively recent test, a log cabin was built in three weeks, using stone axes) and, with a crude knowledge of ceramics, he could provide himself with "chinaware."

An elementary knowledge of minerals, woodworking and metallurgy will enable him to extract ore from the ground, to make patterns and molds so that he can cast tools and even parts of machines. From vegetable fibres, he could spin yarns and weave cloth (having made the spinning wheel and loom) and, given time enough, could create for himself all of the conveniences of modern civilization, including means of transportation to bring him back home.

While the foregoing is purely rhetorical, it is nevertheless a poignant illustration of the importance of a knowledge of fundamentals when solving tooling problems. And, it bears directly on modern practices. For example, the bow drill shown in Fig. 1 has its counterpart in modern tools, like the stonesetter's (jeweler's) bow drill shown in Fig. 2. These drills were almost universally used in jewelry manufacture twenty-five years ago, and are still used, although they are being superseded with small power driven tools. For small holes, the bow drill is not only fast but very easy to operate.

Everything considered, then, it may be said that this historical sketch will lend clarity to the entire work, and that it is therefore necessary to the thesis. And this first installment, being in the main introductory, will serve as a springboard from which we may take a "swan dive" into the main subject matter.

While the entire series will be based on fundamentals, it is proposed to include the major classifications of drills, cutting tools and accessories employed, as well as fixtures. It is therefore suggested that readers follow the work through from the beginning, even though they may be quite familiar with the subject matter covered in any one installment, and that installments be filed until the series is completed. That way, there will be no break in continuity.

At this point, we may acquaint ourselves with some of the terminology applied to drills. These may be had, in part, from Fig. 3, in which is shown web, margin, body clearance, chisel edge, point angle, lip, lip clearance and helix angle. To these may be added such identifying characteristics as straight and taper shanks, wire gage and jobbers drills, bonding drills, straight flute and multi-flute drills and so on through a gamut of classifications and trade names. These will be elaborated on in following installments.

Because twist drills are used for many purposes and for many different kinds of materials, it is essential that the reader acquaint himself with the type, or types, best suited to his specific requirements. For example, the flat drill shown in Fig. 4 (the flat drill of our forebears) is widely used in modern practice as starting or center drills in turret lathe tooling, and for drilling various soft metals.

The drill shown in Fig. 5 is for drilling slate. It will be noted that the spiral is steep, with minimum section to the flutes. This provides a greater space for chips than is found in conventional twist drills, and is necessary because chips from slate break into small particles which do not readily pass back along the flutes until the volume of chips is sufficient for continuous movement. Hand feed is usually employed, with surface speed around 12 fpm (feet per minute) for carbon drills. With high speed steel and carbide tipped drills, cutting speeds will be proportionately higher.

Flat drills (or helical groove drills with the cutting edge parallel—or nearly so—to the axis) are best used for such materials as lead, copper and soft brass. In such materials, a hooked cutting edge has a tendency to bite into the work, especially when breaking through, with consequent danger of breakage or injury to operator or equipment.

The right speed, for a given size of drill or a given material, is extremely important if one is to obtain maximum cutting efficiency. The same, of course, goes for the right feed. Unfortunately, one can only obtain approximately correct speeds with the average geared head or stepped cone drive drill press. Ideal conditions can only be had with variable speed transmissions.

Few drill presses, however, have speed ranges sufficiently high for very small drills. For example, a surface speed of 80 fpm (or sfm—surface feet per minute) for a 1" drill would be about 300 rpm (or R.P.M.—revolutions per minute) whereas a 1/16" would have to run about 5000 rpm for the same surface speed. For a 1/64" drill, the speed would be close to 20,000 rpm—far beyond the range of the average drill press. Of this, more in later installments.

That the student-reader may accelerate his course in "hole engineering," it is suggested that he critically study the various advertisements, on drills and drilling techniques, in the advertising pages of *The Tool Engineer* and contemporary trade magazines. Modern advertising provides vital information on "ways of doing," valuable alike to beginners and veterans.

End of Part 1. Installment No. 2, this series, will follow in the September issue, The Tool Engineer.

FIG. 3

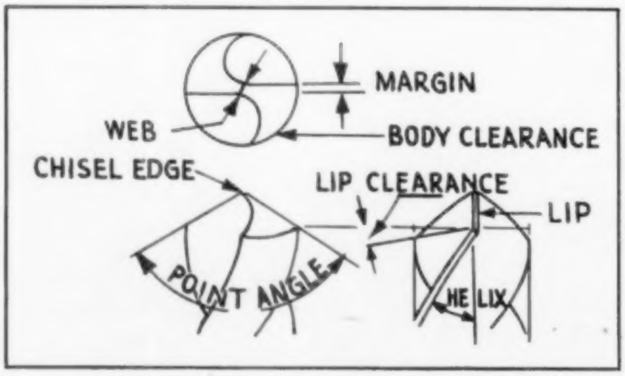
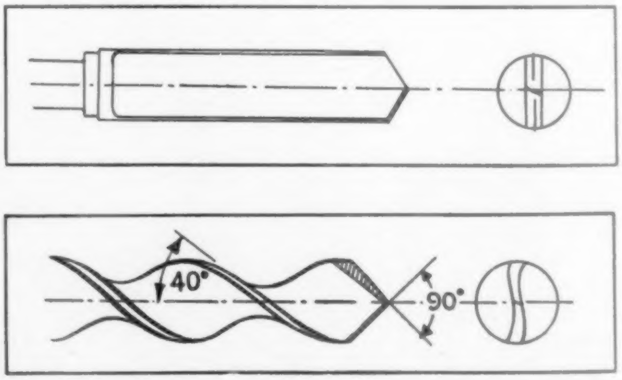


FIG. 4, at top

FIG. 5, below



GOOD READING

A Guide to Significant Books and Articles of Interest in the Trade Press

INCREASED PRODUCTION THE SOLUTION TO ECONOMIC PROBLEMS, in July *Machinery,* summarizes the timely address delivered by Joseph L. Trecker, Executive Vice-President, Kearney & Trecker Corp'n, Milwaukee, before press representatives gathered in that city. The speaker pointed out that increased worker income, which is not based on increased production, is now already being lost through rise in living costs. Therefore, new machines, with higher productivity, are absolutely necessary; but he was careful to explain that these machines must not increase the worker's physical effort, discomfort or operational hazards.

Emphasis was also placed on the subject of individual compensation, with the speaker stating that wages should be limited to output, not to the time clock. He then analyzed the unsound argument offered by certain workers who believe the less work they do, the more work there will be left for others. The speaker concluded that such reasoning is fallacious, and that real progress towards solution of our economic problems will come only when workers finally realize that jobs depend on more productivity, not less.

Also in the same issue, **MACHINING STAINLESS-STEEL VALVES,** by A. P. Nelson, Works Manager, Alloy Steel Products Co., Inc., Linden, N. J., discusses practices and tools for turning, drilling and threading stainless steel parts, with mention made of a suitable coolant.

The author found that a surface speed of from 55 to 85 feet per minute was satisfactory for turning on turret lathes, depending, of course, on the alloy being machined. In drilling, feed must be constant "to prevent dwelling of the drill, with consequent work-hardening." The art of tapping and threading is discussed and suggestions made, such as the proper use of a collapsible tap, and the use of speeds of 15 surface feet per minute for maximum tap life.

WHAT FUTURE FOR CONTRACT TOOL SHOPS? By Burnham Finney, in July 4, *American Machinist,* reveals results of a three-question survey which had been sent to customers, and tool and die manufacturers.

Question number one: "What in your opinion constitutes a first-class contract tool and die shop?" Underlying many of the answers was the belief that a good shop must have adequate facilities and top-notch inspection as primary prerequisites.

Question two: "What specific advantages do contract tool and die shops offer the manufacturer which makes it practical for him to purchase his special tools and dies outside rather than make them himself?" Many felt that by hiring outside firms for tool and die work, manufacturers can thus limit their investment in non-productive capital equipment; and they also replied that manufacturers stand to gain materially, because outside shops provide a high type of specialization.

Question three: "What do you see ahead for the contract tool and die shop?" Replies were generally optimistic, but there was ofttimes an added note of caution. For it was felt that tool and die plants must make every effort to give customers a still higher type of quality, service and cooperation, if they are to continue to prosper.

EVALUATING SURFACE DURABILITY OF GEARS, by T. H. Wickenden, G. R. Brophy & A. J. Miller, in July *Machine Design,* describes a testing machine for determining surface durability of gears, and also the testing procedures employed by the Development & Research Div'n of The Internat'l Nickel Co., Incorporated.

The machine operates on the "four-square," or closed circuit principle wherein two pairs of gears are opposed—one pair being a permanent part of the machine and the other the test specimens. The article states, "The gear train is driven by three V-belts at a speed of 900 rpm by a 3-hp, 1200-rpm induction motor mounted beneath the table at an angle of $7\frac{1}{2}$ degrees from the horizontal."

A "Kontak," high impedence microphone, mounted on the weight lever, is used to check the pitting of the gears, by noting variations in volume and tonal quality of the sounds emitted during the test runs.

TOLERANCES IN QUALITY CONTROL, by Eugene Goddess, Head of Factory Eng'g, North American Philips Co., Inc., in July *Mill & Factory,* discusses the balance between permissible tolerances and the economic cost of attaining the desired quality of product. The author believes, of course, that such a balance is the responsibility of the quality control department; but he also makes a plea for closer cooperation between Quality, Production, and Design Engineers, to obtain results on the establishment of initial tolerances that are not only workable but sensible.

Also, in the same issue, **MAINTENANCE OF CARBIDE TOOLS,** by John E. Hyler, stresses the importance of using diamond hones, and special grinders, to hone carbide tools, thus reducing the amount of grinding necessary.

A chip breaker grinder is mentioned that not only grinds regular chip breakers but, as the author describes it, "takes care of chip breakers in roller turner tools, grinds the tops of boring bits, grinds relief angles and radii in boring bits, and can even be set up for grinding flat form tools." Another grinder "makes it possible to grind convex types of single point tools with constant relief angles as measured in the direction of tool feed."

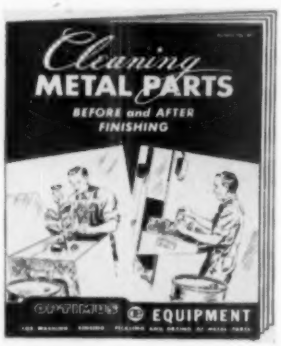
The author concludes with a discussion of a profile grinder, which uses a diamond wheel to grind any desired profile in cemented carbide tools.

DEEP DRAWING AND "BULGING" OF STAINLESS STEEL, by J. E. Obernesser, Gen'l Sup't, Internat'l Harvester Co., Inc., in July 1 issue of *Steel,* analyzes the manufacture of such stainless steel dairy equipment as milker pails for milking machines, where unusual requirements of surface finish must be maintained to meet rigid sanitary specifications. Forming operations must be free of die marks, thus precluding the lodgment of milk or dirt particles in the finished product.

Also in *Steel,* July 8 issue, **WET BELT MACHINING,** by William F. Schleicher, Porter-Cable Machine Co., describes grinding, surfacing, and removal of stock by the new *wet* belt machining method. Cutting action of the abrasive belt—at speeds from 2500 to 4500 fpm—is made possible by use of a new plastic bond which securely holds the abrasive to a processed cloth belt.

BULLETINS AND TRADE LITERATURE

Items briefed herein have been carefully selected for their interest and application. Unless otherwise stated, all are available, free, from the stated sources.



Bulletin No. 6E1, published by **OPTIMUS EQUIPMENT CO.,** 313 Church St., Matawan, N. J., describes their line of cleaning and drying equipment and detergents. A table shows how seven basic type units can meet and handle 12 operating conditions. Several models are adaptable for drying operations using hot or cold air, and steam, gas, or electrical heating.

Norbide: the Hardest Material Made by Man, a booklet of the **NORTON COMPANY,** Worcester 6, Mass., describes Norton Boron Carbide (Norbide) for use as a hard abrasive in powdered form; and also explains its adaptability to resist abrasion when used in molded shapes for dies, gages, nozzles and anvils.

Nickel Alloy Steel Castings in Industry, a 28-page catalogue of **THE INTERNAT'L NICKEL CO., INC.,** 67 Wall St., N. Y., is a pictorial presentation, with a minimum of text, concerning the varied uses for nickel alloy castings, including many machinery and equipment parts applications.

Chrysler Airtemp Liquid Cooler, an 82-page publication of the **AIRTEMP DIV'N, CHRYSLER CORP'N,** Dayton 1, Ohio, explains how the Chrysler Airtemp PL-300 Liquid Cooler solved cutting oil and coolant temperature control problems in a wide variety of machine tool installations.

RFC SMALL BUSINESS ACTIVITIES FOR FEBRUARY AND MARCH, 1946, is the most recent report released by the *Reconstruction Finance Corp'n,* Washington, D. C. 1027 Blanket Participation Agreement Loans, aggregating over 48 million dollars, were authorized during the month of March. The report explains that such loans were issued by banks for longer maturities and for a broader scope of purposes than previously.

Leading the list, in first place as regards dollar value, were 400 loans made to the metal working industries, amounting to over 20 million dollars for the month of March, 1946.

Titeflex, an attractive 36-page catalogue of **TITEFLEX, INC.,** 500 Frelinghuysen Ave., Newark, N. J., lists sizes and types of their line of all-metal flexible hose, and assorted fittings, with valued suggestions as to their most effective use.

Design-for-Progress Award Program, a set of rules published by **THE JAMES F. LINCOLN ARC WELDING FOUNDATION,** Cleveland 1, Ohio, gives details of the contest which will award $200,000 for winning articles submitted before June 1, 1947, on arc welding. Best paper will receive $13,200, and there are 451 other awards.

Fluorescent Lamps, a 22-page booklet of the **WESTINGHOUSE ELECTRIC CORP'N,** Lamp Div'n, Bloomfield, N. J., discusses the mercury vapor electric discharge tube, ballasts, starters and lampholders. Authored by Eugene W. Beggs, Mgr. of the Vapor Lamp Section, it includes many sketches and is written in a style that is easy to understand.

PIONEER ENG'G & MFG. CO., 19669 John R St., Detroit 3, has released a 24-page booklet, *The Answers to Industry's Problems,* showing the place occupied by their independent engineering organization. A complete story is presented on how the company functions and the scope of its many services available, including the designing of products, machines and tools; production methods, and the control and flow of production; plant layout; internal organization; material handling; and quality control. Also available, from the Pioneer organization, are time and motion study and cost control services.

AMERICAN WELDING SOCIETY, 33 W. 39th St., New York 18, has published *Recommended Practices for Automotive Flash-Butt Welding,* under the auspices of its Automotive Welding Committee (Price 30c). The 22-page booklet, replete with drawings and charts, discusses material, equipment, design, inspection and technique; with the largest single portion devoted to tooling of clamping arrangements, electrodes and cam contours as applied to successful flash-butt welding.

AEROQUIP CORP'N, Jackson, Mich., has issued *Bulletin No. 102,* describing Aeroquip self-sealing hose couplings, as well as their line of flexible tubing in 2 or 3-layer cotton braided styles, and their No. 303 hose which is a single wire and 2-layer cotton braided type.

Milling Cutters and How to Use Them, a 50-page reprint, offered by **THE CINCINNATI MILLING MACHINE CO.,** Cincinnati 9, Ohio, first appeared serially in the "American Machinist," 1945. Compiled by M. Martellotti, the booklet is based upon years of research covering milling practices.

The German periodical *Kunststoffe* (plastics), official publication of the Synthetic Products Division of the German Chemical Society and the Society of German Engineers, is being reprinted in the United States, in 31 volumes, covering years 1911-1941, and will be available from **ACADEMIC PRESS, INC.,** 125 East 23rd St., New York 10, for $375 per set.

Those already familiar with Kunststoffe know it as a periodical devoted to the production and use of chemically ameliorated natural products and truly synthetic materials. The magazine covers the field of plastics and other high-molecular organic compounds such as rubber, and particularly synthetic rubber. It also includes much material on the development of machinery for production of synthetics, molding and extrusions, equipment for testing, comprehensive patent information, and also summarizes papers presented at the various meetings of scientific societies insofar as they pertain to plastics.

Contributors to the periodical include several department heads of the I. G. Farbenindustrie Ges., like Kranzlein, Loblein and Dreher on polymerization, production of Buna synthetic rubber; Rohm and Haas writing on their plastic developments; Raschig, Beck, Thiessen, Seeback and many other contributing articles on various types of plastics, their production and applicability.

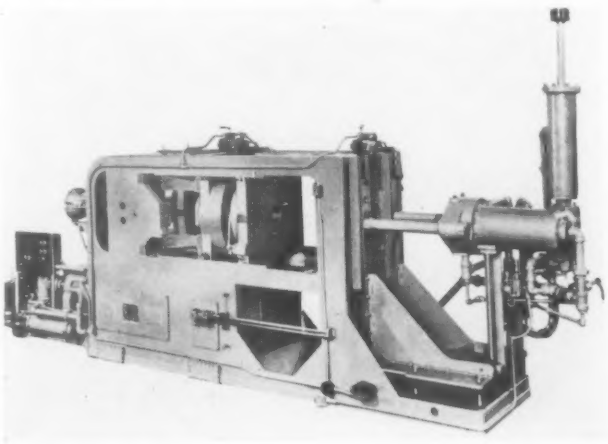
Although the complete set costs $375, the publishers will quote prices on single volumes upon request to their New York offices.

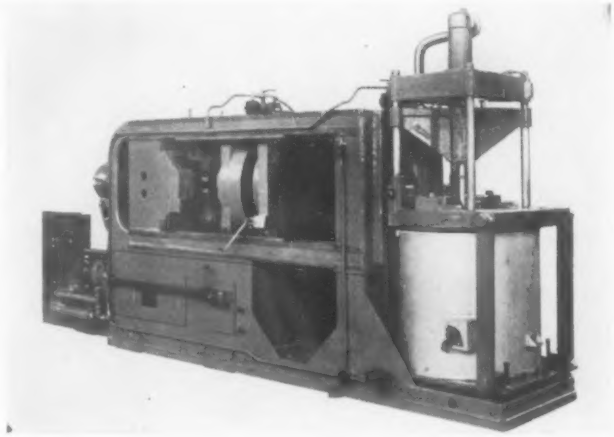
TOOLS OF TODAY

New L-P Die Casting Machines

Two NEW **DIE CASTING MACHINES,** for the production of large, heavy castings, are offered by *Lester-Phoenix, Inc.*, 2711 Church St., Cleveland 13. These are models HP-3-½-SF for zinc, tin and lead alloys, and HP-3-½ X-SF for aluminum, brass and magnesium.

The two machines have the following features in common: Machine frames of one piece steel castings, said to achieve the greatest rigidity ever developed on a die casting machine. Cross section area of the frame is 240 inches, equal to the area of four 8¾" tie bars, which are here eliminated as a result of integral construction. There are no interfering bars or other encumbrances, and dies are lowered through large openings in the top of the frame.



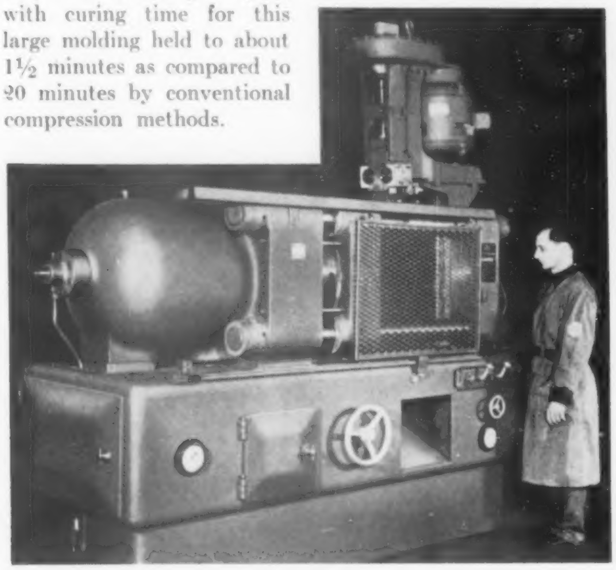


The central die support (said to be exclusive with L-P) has been increased in size, and the movable die plate, bearing on all corners, eliminates possibility of deflection when die is closed. The aluminum machine is equipped with the patented Lester-Phoenix pre-fill injection system, which injects metal rapidly, at controlled speed, then applies the greatest pressure as the metal chills in the die. This equipment develops injection pressure up to 33,000 psi applied to castings up to 40" in projected area. Higher pressures psi can valuably be applied to smaller castings.

Turbojector by H. P. M.

A NEW revolutionary machine—the **H.P.M. TURBOJECTOR**—for production molding of both natural and synthetic rubber is announced by *Hydraulic Press Mfg. Co.*, Mount Gilead, Ohio. Designed for molding a wide variety of mechanical parts, the machine is a completely self-contained, automatic cycle unit and injects rubber into a hydraulically clamped mold by means of a motor driven screw.

Actual production results indicate that rubber parts molded with the Turbojector have superior physical properties as compared to those molded by conventional compression methods. Production costs are said to be greatly reduced, reforms are eliminated, curing time greatly reduced and, as flash is also eliminated, finishing operations have been proportionately reduced. As an example of production capacity, 100 rubber bushings, ⅞" dia. x 1⅛" long approx., may be molded per cycle, with curing time for this large molding held to about 1½ minutes as compared to 20 minutes by conventional compression methods.



Plastic Insert Remover

FASTER and more powerful pneumatic **INSERT REMOVING** tools, for removing threaded inserts from plastic molds, have been introduced by the *Keller Tool Co.*, Grand Haven, Mich. Model 1458 has a torque of 8 ft. lbs., while the lighter companion—Model 1459—has a 2 ft. lb. torque. Both models run in either direction and weigh only 2½ lbs.

Originally designed to speed certain molding operations in the manufacture of telephone instruments, these powerful tools greatly facilitate the removal of both external and internal threaded inserts.

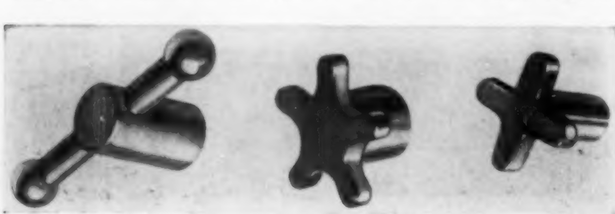
On-the-spot Die Casting

Die casting, the economical short cut between raw metal and finished product, may now be done on-the-spot in practically any machine shop with the **DCMT DIE CASTER**, announced by the *DCMT Sales Corp'n*, 401 Broadway, N. Y. This machine will be sold exclusively through machine tool dealers, who will supply completely pre-fabricated blank die sets. The only requirement is machining the cavity and grinding the gate.

The machine takes only a few minutes to set up, and low or high production runs—up to 600 shots per hour—may be made as desired. The inset shows typical products cast with this machine.

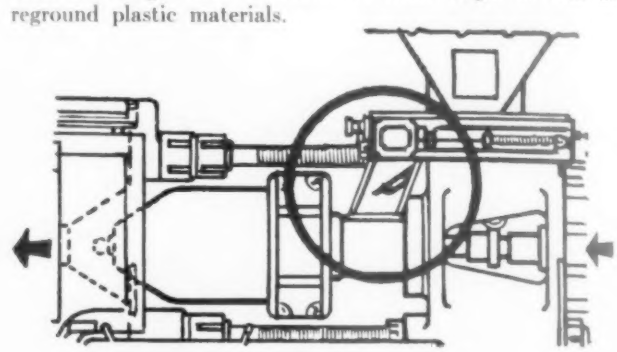
Hand Knobs Available

Three new types of **HAND KNOBS** for machines, fixtures, and other uses have been added to the line of accessories by *Machine Products Corporation, Detroit.* These knobs are cast iron and are supplied either machined or rough. The four-star design is available in 6 sizes, the 5-star in 2 sizes, and the "T" handle design in 2 sizes. Hand wheels are also available either rough or machined, with or without polished steel handles. A new catalog giving complete dimensions and prices will be sent upon request.

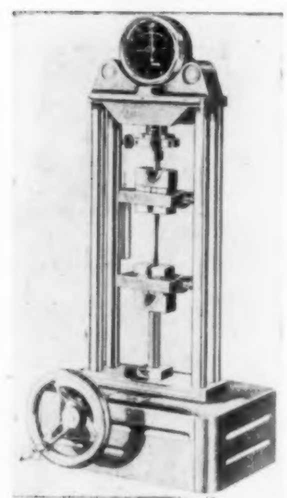


Magnet for "Tramp" Iron

As a special addition to the Standard and "Jumbo" line of magnets manufactured by *Eriez Mfg. Co.*, Erie, Pa., a new **NON-ELECTRIC MAGNET** by that company is said to successfully remove "tramp" iron and other ferrous impurities from plastic materials during molding. These impurities in plastic materials used in injection, extrusion and compression molding machines, damage heaters, nozzles and molds, and result in considerable loss of time. The plastic magnet installed in the chute below the measuring cylinder, receives foreign ferrous substances from virgin as well as reground plastic materials.

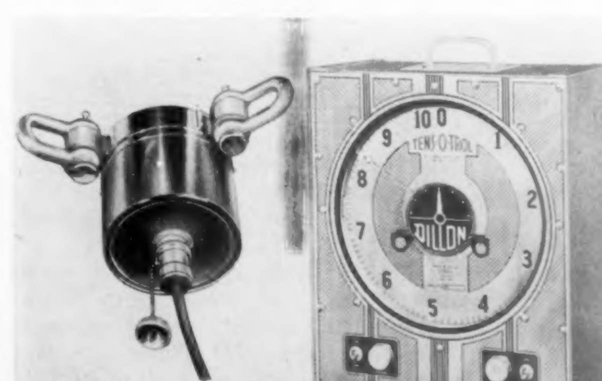


Small Tensile Tester



A compact **TENSILE TESTER**, moderately priced and suitable for loads up to 10,000 lbs., is a recent development by *W. C. Dillon & Co., Inc.*, 5410 West Harrison St., Chicago 44. The instrument will test plastics, nylon, tweed cord and textiles, wood, glass, steel, aluminum and other metals, also springs, for tension and compression. It is widely applicable for use in laboratories, welding shops and both small and large plants requiring a tester within its range.

Also, by Dillon, is the ultra-sensitive Tens-O-Trol, electric remote **TENSION AND WEIGHT INDICATOR.** This dynamometer consists of a master transmitter and two repeater stations, and is designed for a wide range of individual uses, including oil well drilling. It will enable a crane operator to read exact weight of loads, and will indicate load or tension on tow ropes, or on materials to be tested for tension.



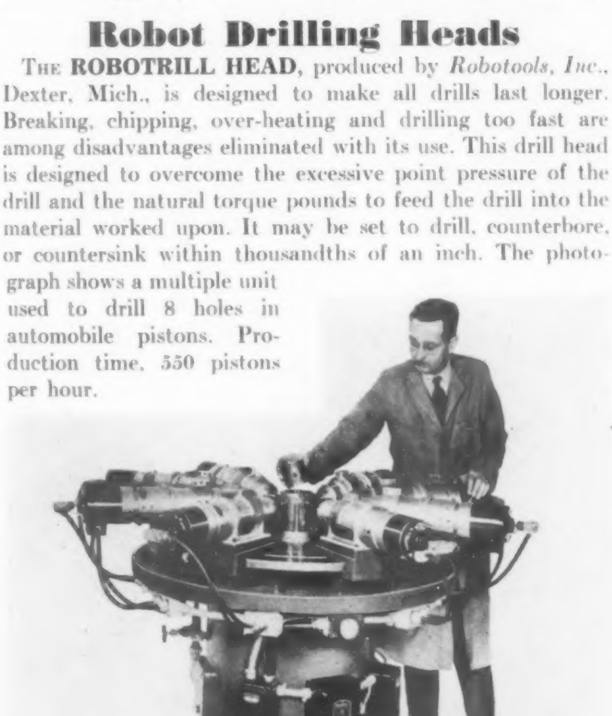
New Super Face Mill

Claims of superior performance are made for **FACE MILLING CUTTERS,** using solid carbide blades, by *Super Tool Company*, Detroit. Only one type of body is required for any kind of material, the only variation being in the angles ground in the solid carbide blades which can be readily altered to suit specified requirements.

A feature of the tool is that it permits the use of solid, unbrazed carbide blanks, held in the cutter body by means of sturdy wedges of Super design. This, the maker claims, obviates the disadvantages of brazing and provides for extended adjustment and insures use of the major portion of the blade. These cutters are available in 6", 8" and 10" diameters, both right and left hand, as standard tools. However, special cutters, bored on the Super principle of tooling, may be made to suit individual requirements.

Robot Drilling Heads

The **ROBOTRILL HEAD,** produced by *Robotools, Inc.*, Dexter, Mich., is designed to make all drills last longer. Breaking, chipping, over-heating and drilling too fast are among disadvantages eliminated with its use. This drill head is designed to overcome the excessive point pressure of the drill and the natural torque pounds to feed the drill into the material worked upon. It may be set to drill, counterbore, or countersink within thousandths of an inch. The photograph shows a multiple unit used to drill 8 holes in automobile pistons. Production time, 550 pistons per hour.

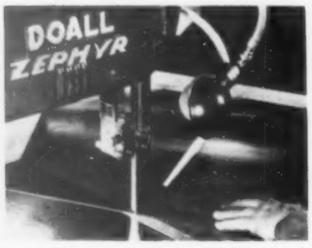


New DoAll High Speed Saw

Designed primarily for light gage steel and foundry application, the **ZEPHYR 16,** recently announced by *The DoAll Company*, Minneapolis, is broadly applicable to woodworking and pattern shops as well as on production lines where it is desired to cut material as fast as it can be fed into the saw. This smaller "brother" of the DoAll Zephyr 36 has a 16" throat depth and a 10" thickness capacity and, featuring the company's patented speed assembly, has an infinitely variable speed range from 1000 to 5000 fpm.

The combination of controlled saw speed and the special DoAll saw blade make very fast cutting rates possible in various materials, including steel springs and links. As compared to conventional metal sawing rates of 1 square inch per minute in steel and 4 square inches in cast iron, the new saw slices through 1/8" stainless at 48.6" lineal per minute, 13 gage sheet steel at 150", 75ST aluminum at 100 square inches. Aluminum, bronze, brass, copper, zinc, gates and risers from iron castings cut about as fast as the material can be pushed into the teeth of the saw. Other materials cut correspondingly fast.

The table is of the tilting type, and there is a disc cutting attachment for making perfect circles, a rip fence and a mitering attachment for cutting of regular and compound angles. Hardened steel saw guides with roller back-up bearing hold the blade firm for straight true cuts to close tolerance.



New Tools by Zagar

New developments by *Zagar Tool, Inc.*, 23880 Lakeland Blvd., Cleveland 17, include **MULTIPLE DRILL HEADS** (shown mounted on 17" Delta Drill presses at left), a Drill Stand and a Toolmaker's Scriber, shown grouped at right.

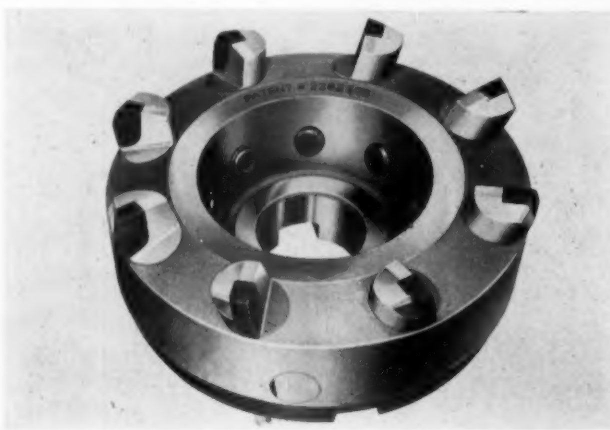
The drill heads, Zagar Series No. 2500, employ the eccentric drive plate, accurately balanced to eliminate vibration at high speeds. This design makes possible very close centers —i.e., centers would be the diameter of the spindles plus necessary bearing wall. The drill stands may be had in maker sizes, or from 1/16" to 1/2" inclusive in multiples of 1/64". The scriber chucks a phonograph needle, which may be quickly replaced.

"Vibra-Cushioned" Cutters

An entirely new line of standard "Vibra-Cushioned" **FACE MILLING CUTTERS**, with carbide tipped inserted blades, has been introduced by *Tungsten Carbide Tool Company*, 2661 Joy Road, Detroit 6. Outstanding feature, claimed, is that they combine the advantages of both inserted blade and fixed blade type of cutters for steel milling, also, the ability to resist vibration—the most destructive element to carbides in the machining of steels.

Vibration dampening is due to "double-cushioning." In the first place, the carbide tips on the blades are extra thick, to give maximum strength. Next, a round type of steel blade, providing more effective backing for the tip, is used. The blade is wedge-locked into a cutter body which, in addition to being slightly heavier than conventional milling cutters of comparable size, has the weight distributed to provide maximum "flywheel" effect. This contributes to smoothness of cutting action.

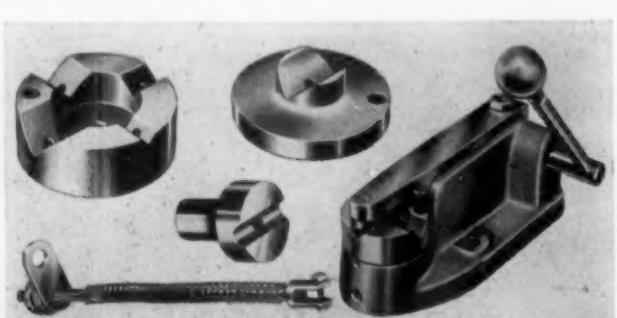
Use of inserted round blades, moreover, has made possible designing the cutter body without external slots as is the case in most inserted blade type cutters. Elimination of these slots, with their tendency to let the blade 'give' under pressure, is said to impart a high degree of rigidity, simulating a solid cutter.



Kam-Grip Drill Jig

A new type of drill jig, so simple in principle that the illustration is practically self explaining, is introduced by *Manufacturers' Engineering Service, Inc.*, 415 Security Bank Bld'g, Toledo, Ohio. The lever may be operated manually, or, it may be linked to the drill press spindle, when it will operate automatically.

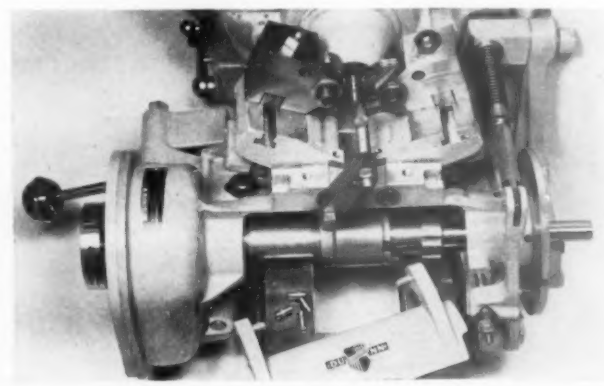
Called the **KAM-KLAMP**, and essentially designed to drill cross holes in small round parts, it employs interchangeable Vee anvils as locators. Clamping is effected by a cam, insuring firm grip, and opening is by means of a compression spring that clears the bushing plate for loading and unloading.



"Dunamatic" Attachment

Dunn Engineering Co., 6341 Lyndon, Detroit 21, has completed engineering work on its **"DUNAMATIC"** attachment for Atlas & Logan lathes—or similar—and is now producing these attachments in quantity. With this device, it is possible to accurately produce, automatically, a wide variety of turned parts that, previously, had to be hand machined.

The attachment, which can be mounted without drilling or tapping the machine, employs a face cam to control the operation of pivoted rocker arms which, in turn, control the operations of the tools—form or cut-off—attached to them. Either circular or flat form tools may be used, as desired. Stock is automatically cam fed, by feed fingers, through collets, the whole closely simulating the operation of an automatic screw machine.



New Duplicating Attachment

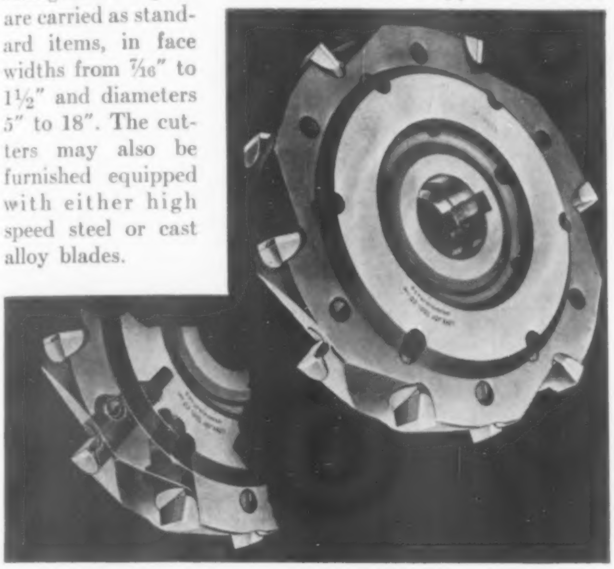
A new and greatly simplified **DUPLICATING ATTACHMENT**, for machine tools, is a recent product of *Bailey Meter Co.*, 1050 Ivanhoe Rd., Cleveland 10. Like the original contour control announced by Bailey in 1944, the attachment is a combined air-hydraulic system which may be attached to vertical boring mills, engine or turret lathes to produce workpieces which will exactly correspond to thin metal templets or master parts.

The device has been simplified by applying a single hydraulic power cylinder to the lathe compound, which is usually set 45° to the longitudinal work axis. When so mounted, and used in combination with the longitudinal feed, the single cylinder controls both longitudinal and in-and-out motion, as against previous use of two power cylinders.

Improved Slotting Cutters

SENSITIVE CONTROL of blade settings, obtained by the addition of a screw adjustment to the blade "positive-locking" device, is the principal feature of the redesigned Type "F" **SLOTTING CUTTER** manufactured by the *Lovejoy Tool Co., Inc.*, Springfield, Vermont. As shown in the phantom view, each blade is set at a slight angle to the cutter body. When blade adjustment is required—either for resharpening or for exact control of slot width tolerances during milling—the positive-locking device is loosened by unseating a taper pin. A recessed-head screw, at the bottom of each blade, is then turned to move the blade up (or retract it) the exact amount required. When properly set, the blade is positively locked in the body by reseating the taper pin.

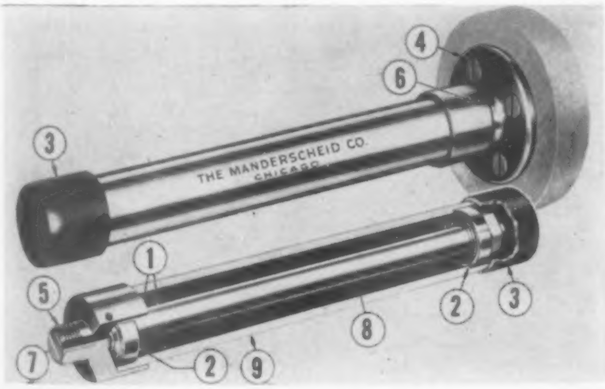
Rigid construction, plus the Lovejoy "positive-locking" device, enables the blades to withstand heavy or intermittent cuts without loosening or breakage. For fly cutting, several blades can be removed without affecting housing strength. Both positive and negative rake Type "F" cutters are carried as standard items, in face widths from 7/16" to 1½" and diameters 5" to 18". The cutters may also be furnished equipped with either high speed steel or cast alloy blades.



Work Holding Spinner

GREATER SPEED and more uniform results, in polishing round, cylindrical and flat circular pieces, as well as a greater ease in handling, is made possible by Presto **WORK HOLDING SPINNERS**, announced by *The Manderscheid Co.*, 810 W. Fulton St., Chicago 7.

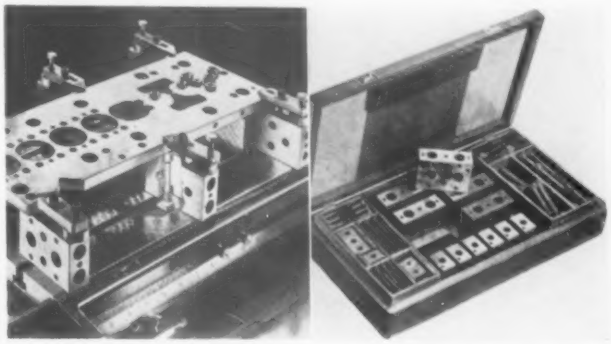
A removable fixture flange, with machined surface, provides for mounting of wood blocks or other fixtures to hold parts of various shapes and sizes. Extra flanges, at nominal cost, permit keeping any number of fixtures mounted on flanges ready for instant use.



3-way Parallel Set-up Blocks

A NEW development in **3-WAY PARALLEL SET-UP BLOCKS**, which build up to twelve different heights and take the place of a large number of conventional parallels, is now available from the *Moore Special Tool Co., Inc.*, Bridgeport, Conn.

Originally designed for precision work in the Moore Jig Borer and Moore Jig Grinder, the complete set consists of six each of two sizes, 1" x 2" x 3" and 7/8" x 1¼" x 1½", packed in a mahogany box for operator convenience in working out any combination of sizes for any particular application. They are equally adaptable for large or small work in the toolroom, on production jobs or for inspection.

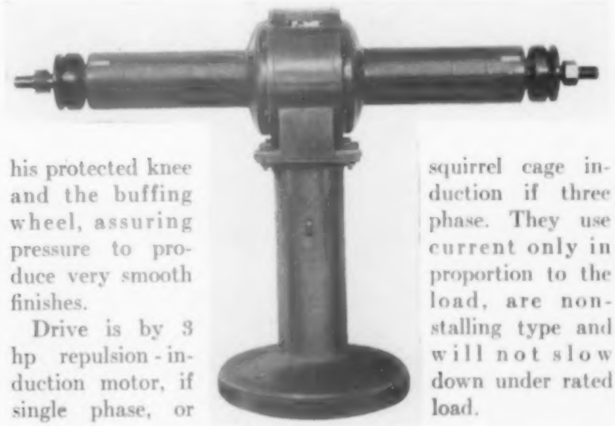


The blocks are drilled and counterbored for bolting to the machine table or faceplate, and will not slide off when attaching work to a vertical surface such as a micro-sine plate, a rotary table when used for radial spacing, or a lathe faceplate. Tapped holes on all three sides permit work to be clamped and supported parallel or perpendicular to working surfaces.

Since the blocks are perpendicular, they may be employed as angle irons, and as gage blocks, where great dimensional accuracy is not required. However, they are finish-ground to tolerance of +.0002" —.0000". Sides are parallel within .0001", perpendicular within .0002", assuring interchangeability between blocks in different sets, in case more than one is used.

Buffer and Grinder

A LOW PEDESTAL TYPE **BUFFER AND GRINDER**, designed especially for the grinding and buffing of plow shares and other long, odd-shaped pieces, is now available from *The Hobart Brothers Company*, Motor Generator Div'n, Troy, Ohio. There is over 40 inches of working space between the wheels and the low design of the pedestal enables the worker to sit at the work and brace the workpiece between his protected knee and the buffing wheel, assuring pressure to produce very smooth finishes.



Drive is by 3 hp repulsion-induction motor, if single phase, or squirrel cage induction if three phase. They use current only in proportion to the load, are non-stalling type and will not slow down under rated load.

Interference Viewer

UNIFORMLY accurate measurements of gage blocks and other precision articles is claimed for the Optron **INTERFERENCE VIEWER,** an entirely new design announced by *Optron Laboratory*, 2663-B Salem Avenue, Box 25, Dayton 6, Ohio.

The interference patterns are both illuminated and viewed on a line perpendicular to the plane of the pattern; as a result, distortion of the pattern, which usually exists in conventional interferometers, is completely eliminated. Each pattern appears the same to different observers, simplifying inspection of one pattern by several observers and removing the chief problem which has hitherto made instruction in optical measurement techniques difficult.

The monochromatic light source is completely concealed, relieving eye strain, eliminating confusing reflections and ghost images which usually make uniform measurements difficult. Furthermore, the type of light source used in the Viewer (with a wave-length of 20.8 millionths of an inch) was selected to give interference patterns maximum brightness and sharpness.

The Viewer also incorporates a feature enabling the user to superimpose the image of any convenient scale on the interference pattern itself, permitting convenient comparisons of straightness or direct measurements between interference bands, without using a ruler or straightedge.

Lubricated Wheel Dresser

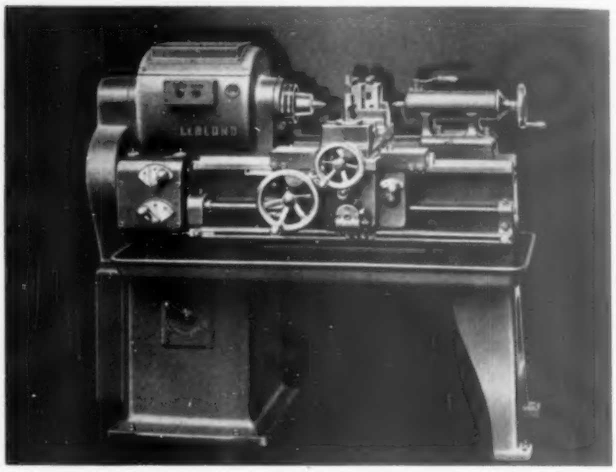
THE NEW **SAMPSON GRINDING WHEEL DRESSER,** by the *G. J. Wallen Mfg. Co.*, 617 Bryant St., San Francisco 7, incorporates forced feed lubrication that insures accuracy and greatly extended life. It will dress and true any wheel now being dressed by star dressers and many others previously dependent on diamonds.

Pressure fed grease precludes entry of grit into the bearings, while centrifugal force, of the rapidly spinning star wheels, throws off any grease and prevents loading.

Rapid Production Lathe

A NEW **13" MOTOR HEAD RAPID PRODUCTION LATHE,** recently redesigned and now in production by *The R. K. LeBlond Machine Tool Co.*, Cincinnati 8, is designed for light cutting at extremely high speeds. Equipped with individual motor drive, the stator and rotor are built integrally with the headstock. The latter contains the stator, bolted to the casting, and a rotor pressed onto the spindle. At top speed, the motor head operates at 5 hp, and is said to run quietly at speeds up to 3600 rpm.

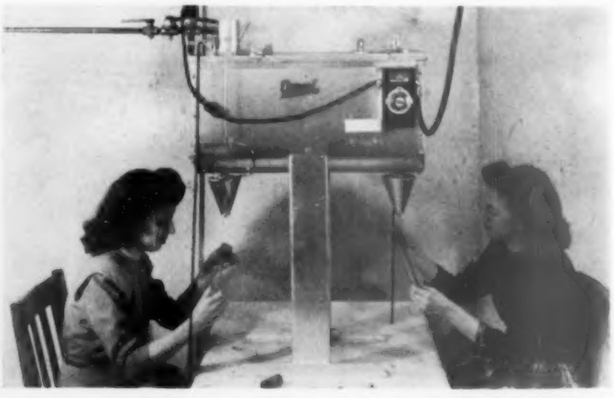
Operation is simple and positive. A touch of the conveniently located start button sets the spindle rotating at any pre-selected speed, while use of the stop button will brake the spindle to a smooth stop within a matter of seconds. Attachments, such as those used on the standard 13", 17" and 20" LeBlond Rapid Production Lathes, are also available for this new motor head.



New Compound Tank

A NEW **COMPOUND TANK**—Aeroil No. 22TGT—by *Aeroil Products Co.*, West New York, N. J., features two outlets, foot valve operated, so that two operators can work with both hands free. This not only doubles productive capacity as compared to single outlet tanks, but facilitates the handling of work. High mounting of nozzles, set standard for streams .208" diameter, permits clear working space.

The tank is gas fired and designed for compounds that will withstand direct heat. Self cleaning valves insure instantaneous flow, and heat is automatically controlled by thermostats. Heat range is from 100 to 550 degrees F. A bulletin, available on request, gives full information.



North East West South in Industry

Shown in the group photo are local committeemen for the **"INSTRUMENTATION FOR TOMORROW" CONFERENCE & EXHIBIT**—sponsored by the **Instrument Society of America**—to be held at the Wm. Penn Hotel, Pittsburgh, September 16-20.

Back row: Committee Ch'men **A. Shafer**, Finance, and **S. Prince**, Publicity; **L. Susany**, Sec'y, Pittsburgh section; **M. Jacobs**, Ch'man Reception Committee. Front row: **M. F. Behar**, Liaison Representative, Instrument & Regulators Committee, ASME; **Clarke Fry**, Treasurer, Instrument Society of America; **Paul Exline**, Ch'man Exhibit Committee; and **R. Rimbach**, Nat'l Sec'y. Meeting jointly during the same week will be the Instruments & Regulators Div'n of American Society of Mechanical Engineers.

Mason Britton has been elected President of the **METAL CUTTING TOOL INSTITUTE,** Hartford, Connecticut. Formerly Vice-President of McGraw-Hill Publishing Co., Mr. Britton has been associated with governmental agencies at various times, including service as Administrator, Surplus War Property Administration and Surplus Property Board.

BERT CARPENTER CO., Birmingham, Mich., has been appointed representative for **Fox Eng'g Co.,** Jackson, Mich., for eastern Mich., northern Ohio, and northeastern Indiana territories. **Ira D. Grove** will continue as factory representative.

R. H. Cannon has been named Merchandising Engineer for the *Abrasive Div.* **NORTON CO.,** Worcester. **W. A. Russell** is taking over Mr. Cannon's former territory. Four appointments as Abrasive Engineers have also been made: **J. L. Tobey** and **W. A. McCune, Jr.,** assigned the Connecticut and N.Y.-N.J. areas respectively; **W. H. McNeilley, Jr.,** the St. Louis territory, with offices in that city; while **N. V. Crabtree** has been assigned to Michigan with headquarters in Detroit.

John W. Anderson, Gary, Ind., President of the **NAT'L PATENT COUNCIL (INC.),** announces formation of a seven-man board of Governors to head an educational program backing the patent system. Those elected are: **Henry K. Norton,** New York City; **Melvin M. Johnson, Jr.,** Boston; **E. A. Terrell,** Charlotte, N. C.; **Phil T. Sprague,** Michigan City, Ind.; **W. L. McKnight,** St. Paul; **C. B. Hasford,** Dallas, and **Jay C Perrin,** Los Angeles.

Nathan Lester, President of the newly organized **THE LESTER-AETNA TOOL & DIE CO.,** Warren, Ohio, has announced that expanded facilities have made possible a complete engineering and manufacturing service for both die casting dies and plastic molds. The new company—jointly owned by **Lester Eng'g Co.,** Cleveland, and **Aetna-Standard Eng'g Co.,** Warren, Ohio—is a reorganization of the Tool & Die Div'n, Lester Eng'g Co., which has moved its facilities to the new Warren, Ohio, location. No change, however, has been made in the organization and basic operations of Lester Eng'g Co. as producers of Lester Injection Molding and Die Casting Machines.

SUPERDRAULIC CORP'N, Dearborn, Mich., has announced extensive sales promotional plans for the Superdraulic High Pressure Pump and new "Junior" model which make possible finger volume control of speeds and pressures to a high degree of sensitivity in hydraulically operated machines, motors and transmissions. **Ted Nagle,** Vice-President and Director of Sales, also announced that **Florez, Phillips & Clarke, Inc.,** Detroit, has been appointed advertising counsel for Superdraulic.

Carl E. Bolte has been named Executive Secretary of the **NAT'L LUBRICATING GREASE INSTITUTE,** according to announcement by **Wm. H. Oldacre,** Chairman, Publicity Committee. During the war, Mr. Bolte was director of the Industrial Service Div'n, Smaller War Plants Corp'n, Washington, D. C.

Arthur A. Cambria has been appointed new England District Manager — with offices in Shrewsbury, Mass.—for the **U. S. BROACH COMPANY** of Detroit. Mr. Cambria, chief engineer with the LaPointe Machine Tool Company for the past eight years, was previously associated with government Ordnance in an engineering capacity.

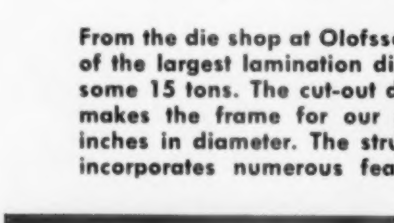
THE SHEFFIELD CORP'N, Dayton, Ohio, has been named exclusive agent for Calibrated Optical Flats and Optron "Interference Viewers," both made by the **Optron Laboratory.**

CARBOLOY CO., INC., Detroit, has appointed the *Providence Mill Supply Co.,* 389 Charles St., Providence 1, R. I., as an authorized distributor, with **K. L. Andrews** in charge of the new service for R. I., eastern Conn., and southeastern Mass. For central and western Virginia, **Frank Hart** will serve as Carbide Specialist for *Industrial Supply Corp'n,* 15th & Franklin Sts., Richmond 15, Va.

North Texas distributor is the recently appointed *Briggs-Weaver Machinery Co.,* 309 N. Market St., Dallas 2, Tex., with **L. H. Leinbach,** Cutting Tool Engineer, in charge of the Carboloy operation. Additionally, **C. W. Marwedel,** 1235 Mission St., San Francisco 3, Calif., has been named an authorized distributor in the San Francisco Bay area.

STORY OF PRECISION

From the die shop at Olofsson has just come one of the largest lamination dies ever built. Weight some 15 tons. The cut-out discs, photo of which makes the frame for our picture, measure 36 inches in diameter. The structure of this big die incorporates numerous features especially designed to facilitate production, and the degree of precision reaches the highest limit possible in die manufacture. Jobs such as this are welcome in the Olofsson plant because they challenge Olofsson ingenuity and engineering skill.



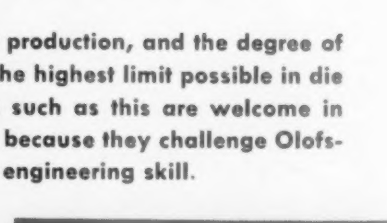
OLOFSSON

TOOL & DIE COMPANY

738 Porter Street • Lansing, Michigan

Chicago Engineering Office • Builders Building

228 N. LaSalle Street Chicago, Illinois



CAMPBELL ABRASIVE CUTTING MACHINES ARE PRODUCTION MACHINES

CAMPBELL MAKES A FULL LINE OF ABRASIVE CUTTERS

Send for your copy of this file-size catalog folder. Ask for DH-1315.

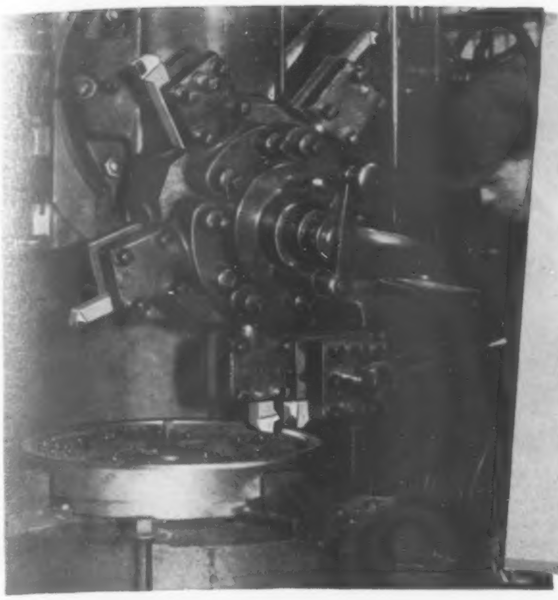
Campbell machines have been developed far beyond the simple function of cutting off materials. The job shown above, for example, is but one of many in which abrasive cutting is supplanting other conventional machining methods—speeding up and economizing production. Write for detailed information.

ACCO

ALSO MAKERS OF A COMPLETE LINE OF NIBBLING MACHINES

ANDREW C. CAMPBELL DIVISION
AMERICAN CHAIN & CABLE • BRIDGEPORT, CONN.

TRADE MARK



5 BIG REASONS WHY CARBOLOY STANDARDS get the call! IN DIESEL MANUFACTURE

CEMENTED CARBIDE

In the progressive Diesel field—where boosting product efficiency, increasing output, and reducing costs are continuing objectives of front-rank importance—more and more companies are turning to Carboloy Cemented Carbides. Here's why:

1 THEY PARE COSTS
2 BOOST HOURLY OUTPUT

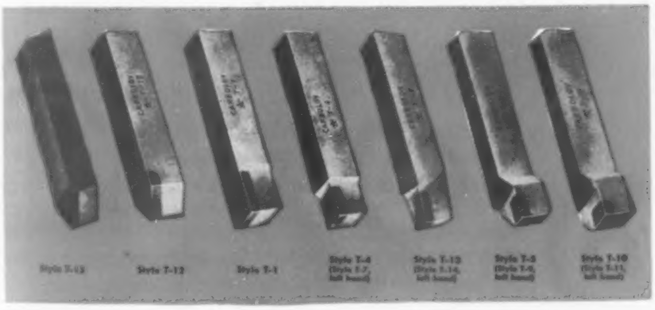
Eight single-point Carboloy* tools replaced an equal number of large, expensive core drills on one operation in Diesel engine manufacture with these results: Cost of new tooling was cut from $240 per set-up to $15. Hourly production was doubled. Direct labor cost per connecting rod was halved.

3 OUTLASTS STEEL TOOLS
4 ELIMINATE EXTRA OPERATIONS

A midwestern manufacturer of Diesel valves switched to Carboloy* Standards for machining the interiors of valve heads. A far smoother surface finish was obtained—the polishing operation was completely eliminated, with a big saving of time—and tool life was increased by 10 times.

5 AND DO THE JOBS THAT "CAN'T" BE DONE!

Recently a shipyard ran into trouble reconditioning Diesel crankshafts on ships of war. The chrome alloy used to build up undersize bearings proved too tough and abrasive for high speed steel, and diamond-pointed tools were too fragile and costly for the job. Lacking a grinder big enough for the operation, Carboloy* G-999 was recommended—machined satisfactorily at moderate tooling cost—and helped speed the needed ships back into service.



Put Carboloy* Standards to work in *your plant*, for greater stamina throughout long production runs—high piece-output-per-tool—high surface finish, almost mirror-smooth—uniformly close tolerances—cutting edge maintained longer between grinds. In every industry these 11 Standard Styles are adaptable to 60%-80% of the turning, facing and boring jobs. They are actually priced lower than ordinary tools in many sizes. Write today for Catalog GT-175R.

The word "Carboloy" is a registered trademark of Carboloy Company, Inc., sole makers of Carboloy Cemented Carbides.

Standard CARBOLOY* TOOLS

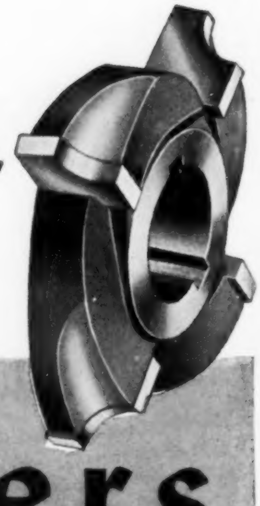
(TRADEMARK) CEMENTED CARBIDE

STOCKED BY AUTHORIZED CARBOLOY DISTRIBUTORS IN 58 CITIES Coast To Coast

CARBOLOY COMPANY, INC., 11124 E. 8 MILE STREET, DETROIT 32, MICH.

CHICAGO · CLEVELAND · DETROIT · HOUSTON · LOS ANGELES · MILWAUKEE · PHILADELPHIA · PITTSBURGH · THOMASTON

For **FASTER SMOOTHER CUTTING, LONGER LIFE and BETTER FINISH—**



Meyers
Carbide Tipped
FORM TOOLS

The Meyers method of generating carbide-tipped tools insures the accuracy of each radius. On milling cutters all teeth are precisely uniform, thereby distributing the work evenly over the entire cutter. This accuracy and uniformity increases the life of the tool amazingly, and insures a much better finish on the work.

We are equipped to grind tools to your specifications, and to engineer special tools for your particular job. Write for complete information, or send us your prints for a quotation.

W. F. MEYERS CO., INC.
ESTABLISHED 1888
1024 14th Street *Bedford, Indiana*

THIS TOOL'S
Got Something!

Under White Light

With ZYGLO
Under Black Light

No mistaking these vivid Zyglo indications — here's positive evidence of cracks and poor bonding.

ZYGLO*

Tells You What

Tool quality is never in doubt when inspection with Zyglo is regular procedure. Good or otherwise—Zyglo tells *all,* in brilliant and easily-interpreted patterns.

Rapid, non-destructive, economical—Zyglo works to benefit both makers and users of all kinds of tools. By ready disclosure of defects *before* rough grinding, it simplifies quality control . . . materially lowers tool manufacturing costs. By unerringly locating flaws *before* they're discovered through failure, it slashes scrapping costs for users . . . eliminates uncertainty in acceptance and use after re-grinding.

You'll profit by Zyglo's all-informative characteristics. Write today for complete information.

**ZYGLO—Reg. U. S. Pat. Off. Trade Mark of Magnaflux Corporation applied to its equipment and materials for the fluorescent penetrant inspection methods which are covered by U. S. Letters Patent No. 2,259,400.*

MAGNAFLUX CORPORATION
5914 Northwest Highway, Chicago 31, Illinois
NEW YORK • DETROIT • DALLAS • LOS ANGELES • CLEVELAND

RESTORE THOSE RUSTED DOLLARS!

New NOX-RUST Non-Corrosive RUST REMOVER

HELPS SALVAGE THOUSANDS IN RUSTED PARTS AND EQUIPMENT!

REPORTS ARE COMING IN from all over the country . . . of factories closed for weeks . . . production held up by shortages . . . of parts piled up . . . assemblies half finished . . . equipment idle . . . of rust slowly spreading . . . eating into inventories . . . piling up costs . . . threatening staggering spoilage losses.

And other reports . . . from companies using Nox-Rust's Non-Corrosive Rust Remover . . . of rust film removed by simple dipping . . . heavy scale by light rubbing . . . of parent metal unharmed even by long immersion . . . tolerances held . . . critical dimensions unchanged . . . machined surfaces restored . . . thousands of dollars worth of rusted material reclaimed.

So . . . if your company has not had the foresight to protect exposed metal surfaces with a Nox-Rust protective coating . . . we suggest this recipe for hindsight: *Try our new Rust Remover* . . . that acts more rapidly than most . . . lasts longer . . . yet is up to *80 times less corrosive* to sound metal, by quantitive tests, than other widely used products. *Immediate Delivery*. For prices, consult our nearest branch office (Newark, Buffalo, Cleveland, Detroit, San Francisco, Los Angeles) or write to us direct, today.

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CHEMICAL CORPORATION

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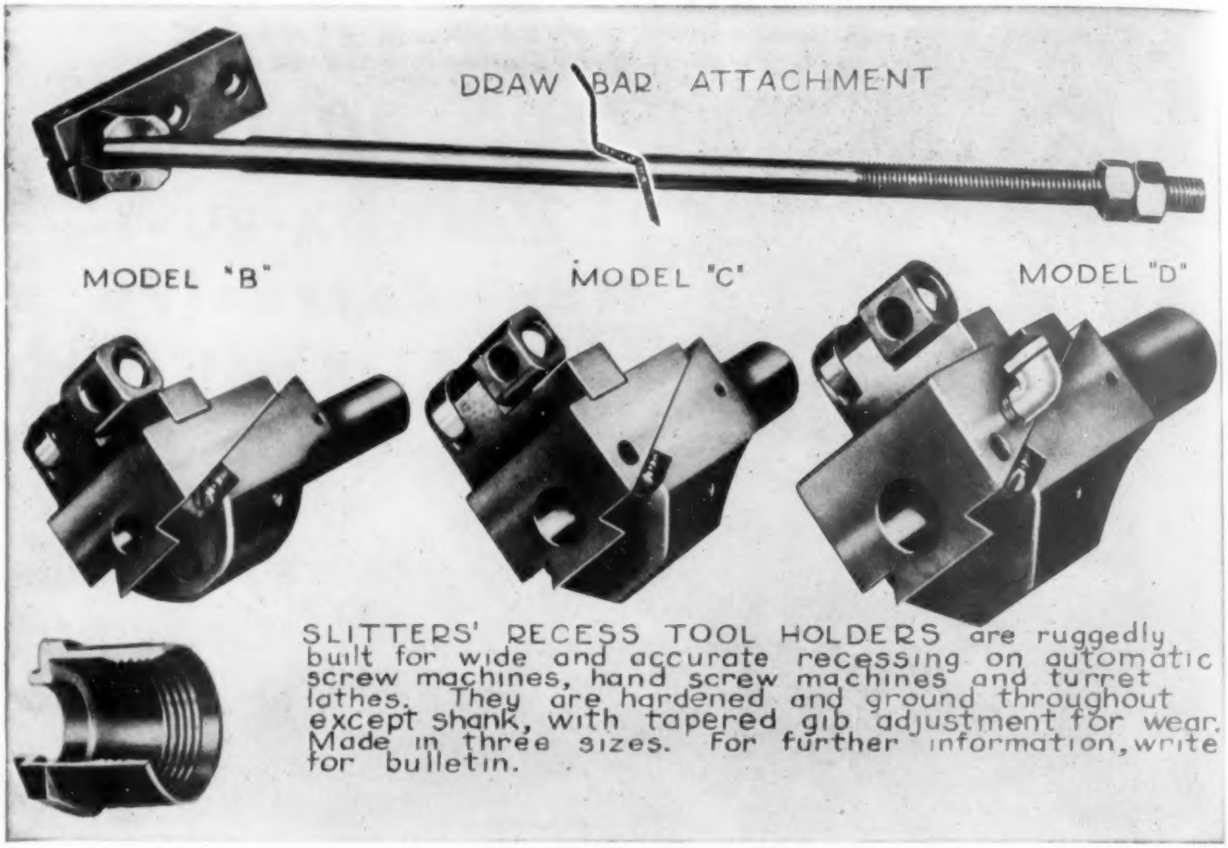


SLITTERS'
SHAVING TOOL HOLDERS

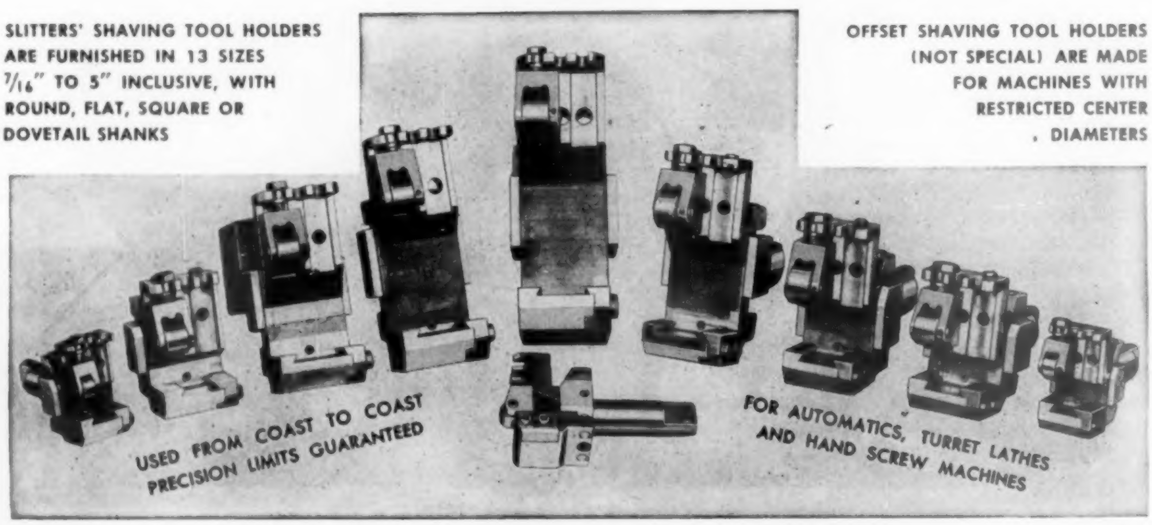
NEW IMPROVED TYPES

LOOSE JAW—FOR EASY TOOL REMOVAL AND TO TAKE-UP VARIANCE IN SIZES

20% STRONGER

SLITTERS' SHAVING TOOL HOLDERS ARE FURNISHED IN 13 SIZES $^7/_{16}$" TO 5" INCLUSIVE, WITH ROUND, FLAT, SQUARE OR DOVETAIL SHANKS

OFFSET SHAVING TOOL HOLDERS (NOT SPECIAL) ARE MADE FOR MACHINES WITH RESTRICTED CENTER DIAMETERS

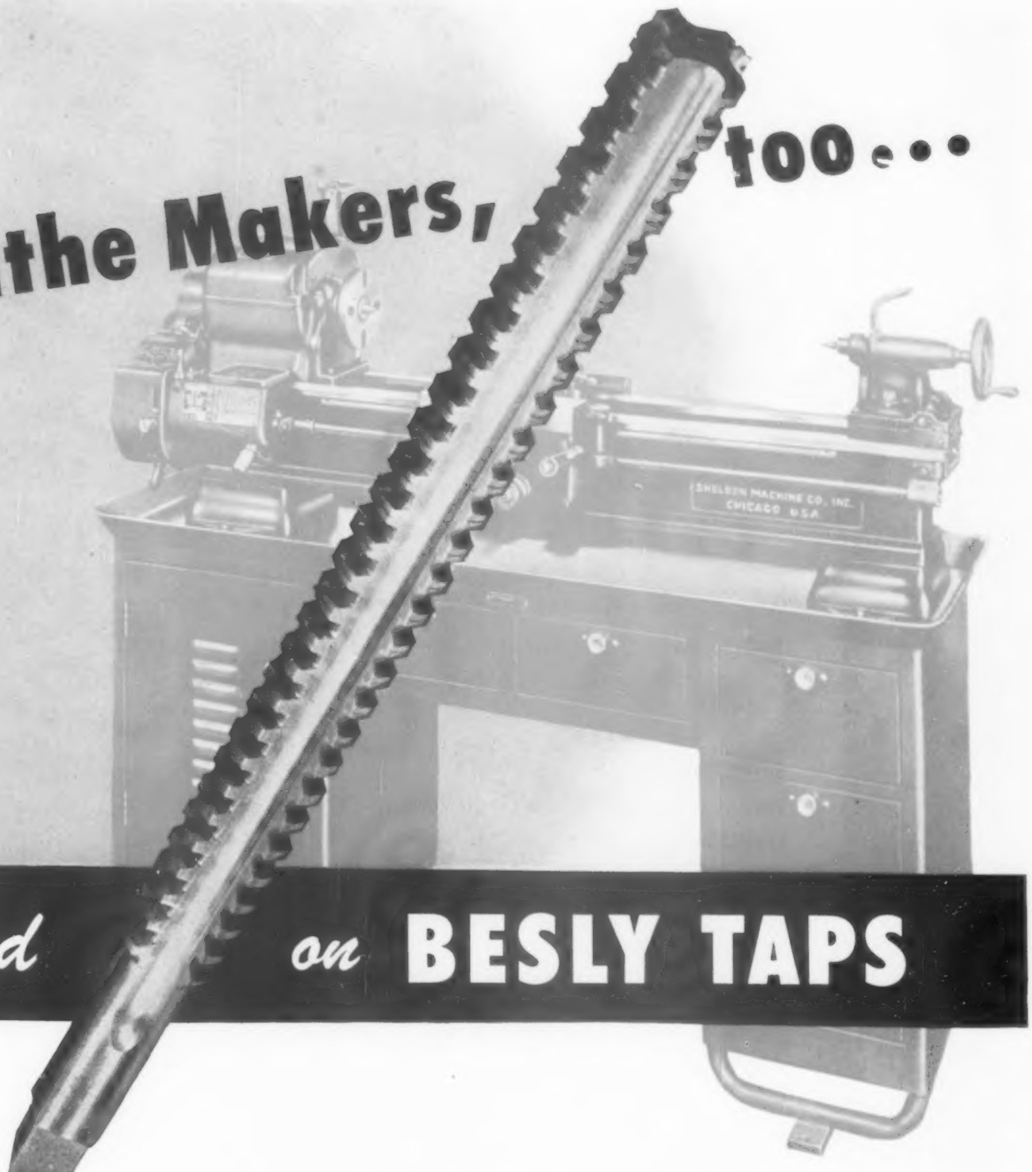


SCREW MACHINE TOOL COMPANY

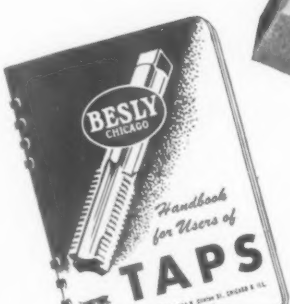
3365-73 GRATIOT AVENUE DETROIT 7, MICHIGAN

MANUFACTURERS OF ACCESSORY TOOLS FOR ALL TYPES OF AUTOMATIC SCREW MACHINES

Lathe Makers, too...



Depend on BESLY TAPS



Helpful Facts For Tap Users

Get your copy of this valuable booklet. It contains vital data on taps and tapping procedures. Tables list various classes of fits. Tap drill sizes and tapped hole sizes are shown in detail. Charts, diagrams and other information on tap grinding and sharpening are also included. *Write today on your letterhead for your copy—free.*

In manufacturing bench and tool room lathes, the Sheldon Machine Co., Chicago, uses Besly Taps to maintain the close tolerances specified in all threading operations. Like other outstanding manufacturers of fine equipment, Sheldon recognizes that precision in a lathe can be no greater than the accuracy of the tools used to build it.

On their record for unfailing performance, Besly Taps have gained nation-wide acceptance for capacity to meet top specifications for clean-cut, low-cost threading. In a stock design or "special" there's a Besly Tap to meet your needs for accuracy, service and economy.

Why not invite the help of Besly engineers in selecting the right tap for the job. WRITE TODAY!

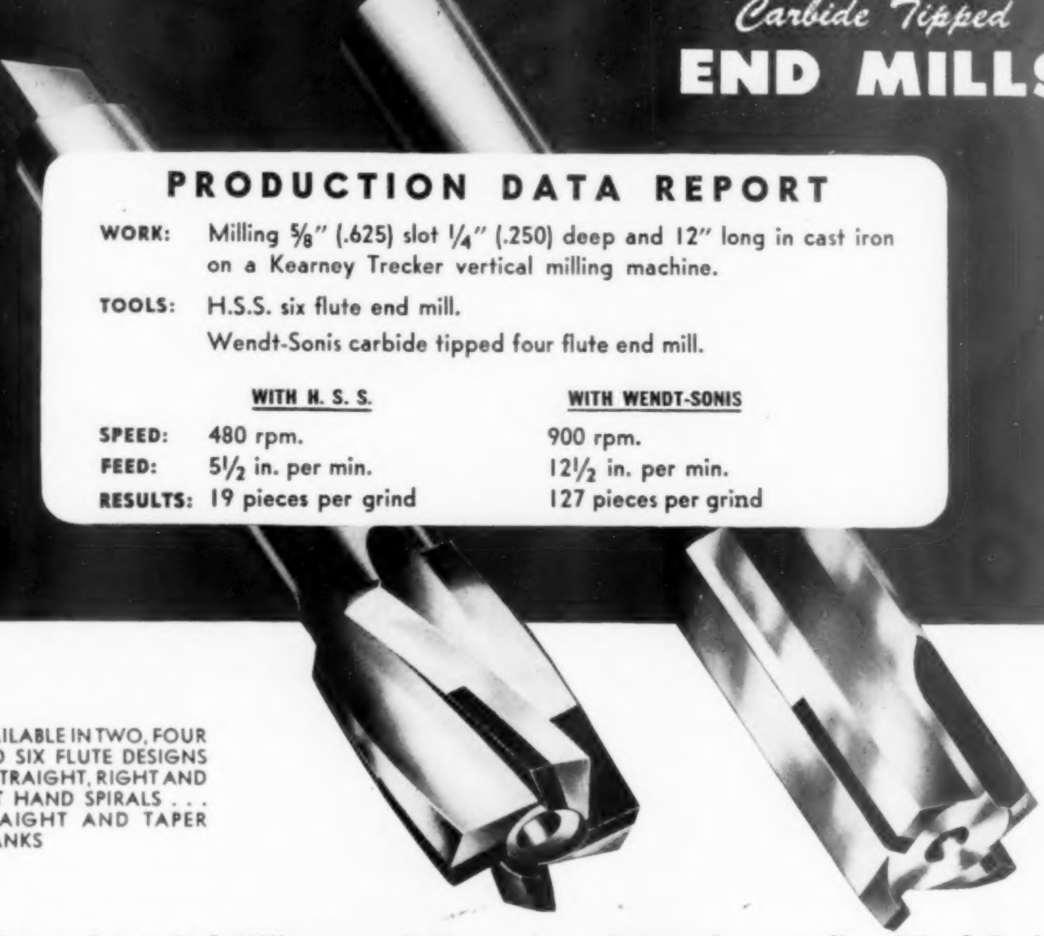
BESLY

BESLY TAPS • BESLY TITAN ABRASIVE WHEELS
BESLY GRINDERS AND ACCESSORIES

CHAS. H. BESLY AND COMPANY, 118-124 N. Clinton St., Chicago 6, Ill. Factory: Beloit, Wis.

Combat Rising Costs....

with **WENDT-SONIS**
Carbide Tipped
END MILLS



PRODUCTION DATA REPORT

WORK: Milling ⅝" (.625) slot ¼" (.250) deep and 12" long in cast iron on a Kearney Trecker vertical milling machine.

TOOLS: H.S.S. six flute end mill.
Wendt-Sonis carbide tipped four flute end mill.

	WITH H. S. S.	WITH WENDT-SONIS
SPEED:	480 rpm.	900 rpm.
FEED:	5½ in. per min.	12½ in. per min.
RESULTS:	19 pieces per grind	127 pieces per grind

AVAILABLE IN TWO, FOUR AND SIX FLUTE DESIGNS ... STRAIGHT, RIGHT AND LEFT HAND SPIRALS ... STRAIGHT AND TAPER SHANKS

WENDT-SONIS End Mills are available for immediate shipment with the correct grades of carbide for milling steel, malleable, cast iron, non-ferrous and non-metallic materials. These carbide tools are exclusive W-S designs. All shanks are scientifically hardened. More cubic inches of stock can be removed per minute. Can be resharpened repeatedly. Wendt-Sonis End Mills will make your production problems easier — help combat rising costs. Get complete details on W-S Carbide Tipped End Mills for use on your work. WENDT-SONIS COMPANY, Hannibal, Missouri, (Tel. LD6) and 580 N. Prairie Ave., Hawthorne, Calif., (Tel. Oregon 8-2655).

WENDT SONIS

CARBIDE CUTTING TOOLS

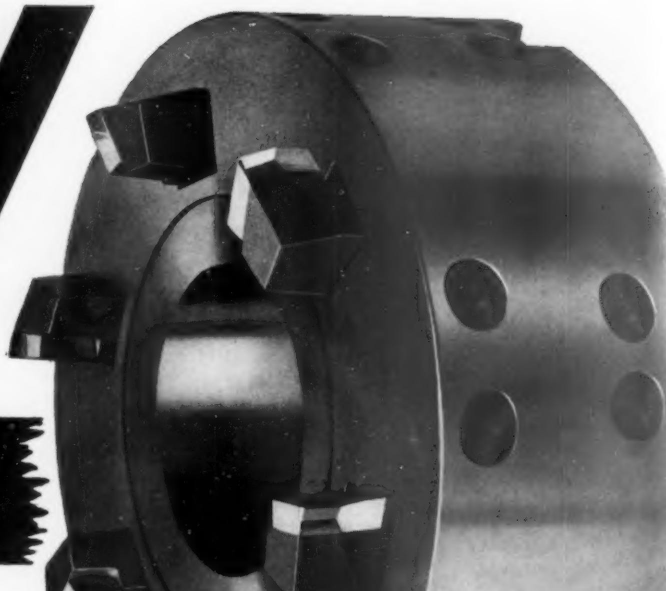
BORING TOOLS • CENTERS • COUNTERBORES • SPOTFACERS • CUT-OFF TOOLS • DRILLS • END MILLS
FLY CUTTERS • TOOL BITS • MILLING CUTTERS • REAMERS • ROLLER TURNING TOOLS • SPECIAL BITS

NEW

LOVEJOY "CUTSALL"

CARBOLOY TIPPED
CEMENTED CARBIDE
TOOL-BIT-TYPE

FACE MILL

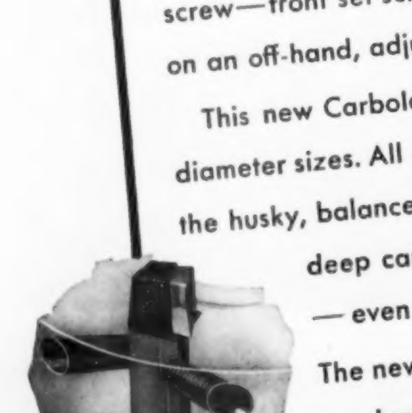


- ***POSITIVE and NEGATIVE RAKE, RIGHT and LEFT HAND in ONE HOUSING***
- ***FINE BLADE ADJUSTMENT***
- ***EXTRA LARGE CARBOLOY TIPS***

Lovejoy proudly presents another new face miliing cutter that is designed especially for the most modern milling practices. The tool-bit-type blades can be supplied for right- or left-hand cutting, *with the same housing*. The extra large Carboloy tips mean extra long wear — the face of the blades is back of center so that positive or negative rake is easily obtained *from the same blades*. The rear on the blade is tapered so that fine adjustment may be made with rear set screw—front set screw securely locks blade in the housing. Blades are sharpened on an off-hand, adjustable table grinder exactly the same as regular lathe tools.

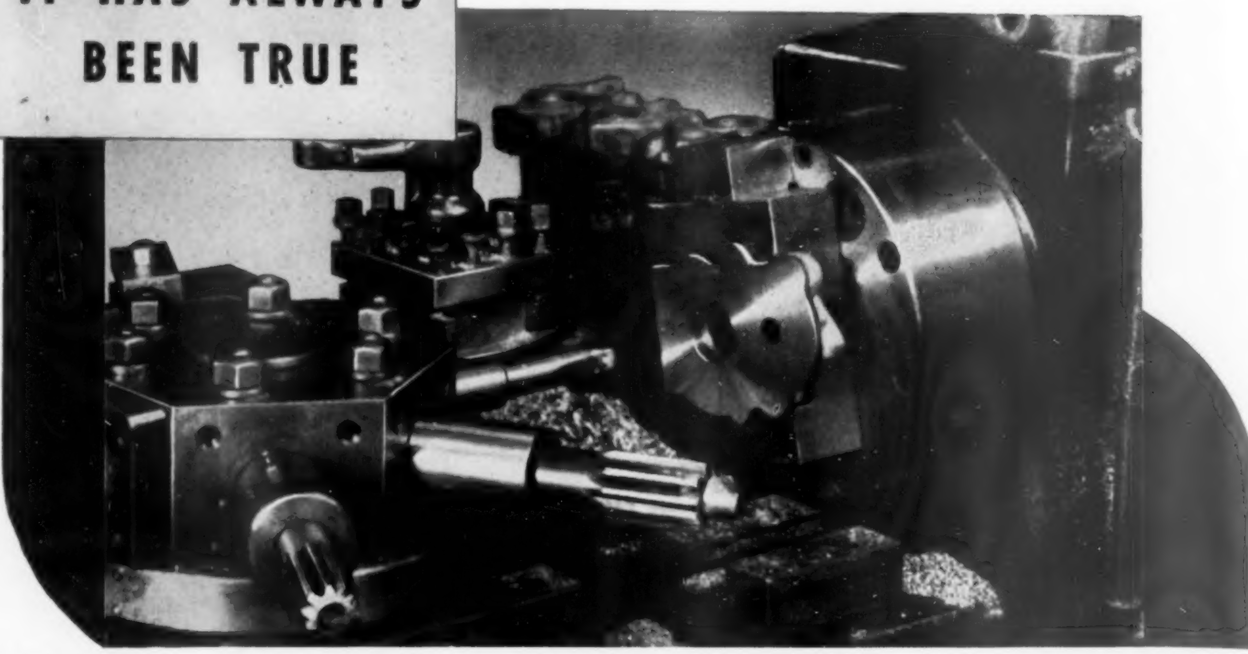
This new Carboloy tipped "Cutsall" cutter is available in 6", 8", 10" and 12" diameter sizes. All sizes use the same blades for convenience and economy. Note the husky, balanced construction—it is your guarantee that facing cuts up to ¾" deep can be taken on tough stock even when spindle speeds are high — even when cuts are intermittent.

The new Lovejoy "Cutsall" has the goods to deliver the goods. Write for production information, prices and delivery — all three will please you.



LOVEJOY
TOOL COMPANY, INC.
Springfield, Vermont, U. S. A.

IT HAS ALWAYS BEEN TRUE



THAT "YOU CAN'T MACHINE IT ECONOMICALLY UNLESS YOU HOLD IT RIGHT"

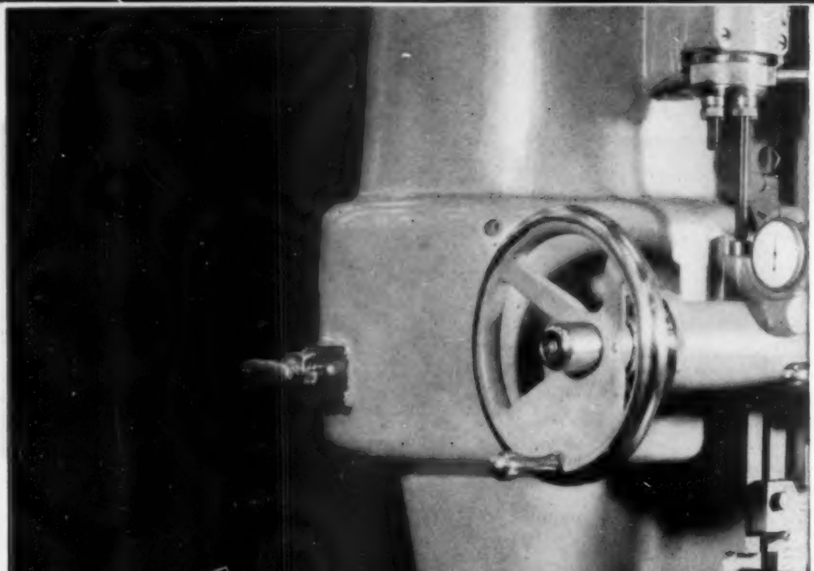
Years ago, "holding it right" meant only having a good husky chuck with a "fair" degree of accuracy and a lot of ingenuity on the part of the set-up man in devising any special jaw devices needed. Today, the fundamentals are the same, but you've got the choice of many specialized types of high precision chucks with accuracy held within at least .003 total indicator error and with time-saving, set-up-saving two piece jaws that permit quick and *exactly* right adaptation to the work piece.

Perhaps you still think in terms of old time methods . . . many shops do. If so, we are sure a consultation with Cushman Engineers will be a profitable aid in solving your pressing cost reduction problems.

THE CUSHMAN CHUCK CO.
HARTFORD 2, CONN.

A WORLD STANDARD FOR PRECISION

CUSHMAN CHUCKS



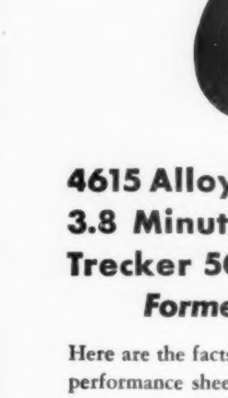
MILLING TIME

CUT 75%

4615 Alloy Steel Forging Milled in 3.8 Minutes on New Kearney & Trecker 50 CSM Milling Machine.

Former Time 15.7 Minutes

Here are the facts of this job taken from the operation and performance sheets. The machining time per piece with the old method was 15.7 minutes. Compare this with the performance shown below:



OPERATION: Face mill four sides

WORKPIECE: Slotting attachment ram

MATERIAL: S. A. E. 4615 forging. 2¼" x 2¾" x 18½"

MACHINE: 50 CSM Vertical

CUTTER: 6" dia., 8 Tooth CSM Carbide Face Mill with 7° negative primary rake angle — .020" wide

CUTTER SPEED: 275 rpm

TABLE FEED: 25 ipm

DEPTH OF CUT: ¼"

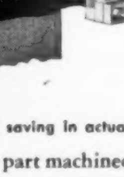
MACHINING TIME: 3.8 minutes ✓

Total saving in actual machining time: 11.9 minutes or 75.8% ✓

The part machined in this job is the operating ram used in a slotting attachment for Kearney & Trecker Milling Machines.

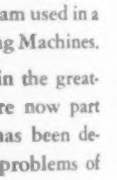
CSM Milling Machines were designed to obtain the greatest benefits from modern cutting tools, and are now part of our line of standard models. The design has been developed after complete analyses of industry's problems of milling with carbide cutters.

CSM machines are available in 20, 30 or 50 hp models in both plain and vertical knee types.



Write for complete data on CSM machines—CATALOG CSM-20. Please indicate your business connection.

KEARNEY & TRECKER
CORPORATION
MILWAUKEE 14, WISCONSIN

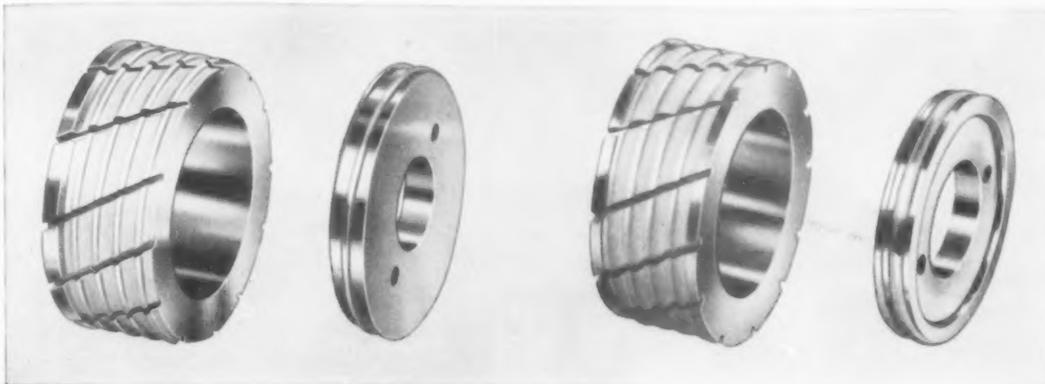


BE READY FOR TOMORROW . . . WITH CSM's

SHEFFIELD MACHINE TOOL DATA

MFG #111

CRUSH GRINDING CUTS MANUFACTURING COSTS OF SMALL AND LARGE SCREW CAP FORMING ROLLS



From left to right - (1) Crusher roll for truing the grinding wheel used to produce the internal die; (2) The resultant internal die; (3) Crusher roll for external die; (4) The external die.

The inner and outer rolls or dies used to roll the thread on jar lids have heretofore been made by chasing on a lathe with a tool formed to the desired thread profile. The rolls are then heat treated and polished. Distortion of form occuring in heat treating is a common cause for rejects.

This problem has been eliminated, production time greatly reduced and uniformity of quality assured by the following methods:

(1) Crusher rolls to desired thread profile are made on standard H.S.S. blanks with the Sheffield Micro-Form Grinder.

(2) The resultant crusher roll is used to dress a 120 grit wheel on the Sheffield Precision Thread and Form Grinder

(3) This Sheffield Precision Thread and Form Grinder is then set up to grind the dies in quantity with two passes of the grinding wheel over the work.

While it was possible to produce the form in a single pass at reduced work speed, the most desirable combination of production time and product finish was obtained by taking two passes, one for rough grinding and one for finish grinding.

In grinding, two parts were placed on an arbor. Total grinding time per part was slightly under 4 minutes. Approximately an hour's labor per die is saved by using crush grinding on Sheffield equipment, and the die so produced is more uniform in quality and the finish is better.

Thousands of other production cost problems can be answered satisfactorily by crush grinding with Sheffield equipment. Write for Bulletins M-100-145 and M-120-144.

THE SHEFFIELD CORPORATION

Dayton 1, Ohio, U.S.A.

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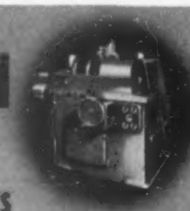
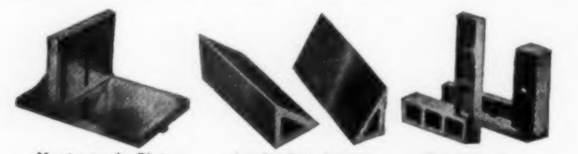


BE READY FOR TOMORROW . . . WITH CSM'S

TOOLS for PRECISION PRODUCTION

MEEHANITE METAL

represents an outstanding development in the metallurgy of gray iron. The process eliminates the undesirable variations of structural constituents which occur in common gray iron. A new material is created in which the structural form of the matrix and the quantity and distribution of the graphite are under actual control.



Masterangle Plates — Angle Attachments — Try Squares

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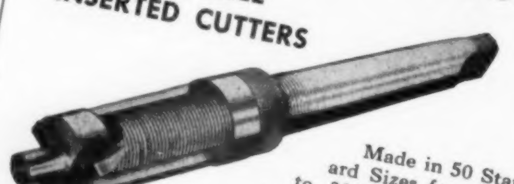
MEEHANITE is an engineering material with strength properties that place it in competition with other strong metals.

•

COUNTERBORE and SPOT FACER

with MOVABLE INSERTED CUTTERS



Made in 50 Standard Sizes from 9/16" to 3½" diameter. Features include—easy removal of cutter for sharpening, cutting edge of cutter always in same location, cutter locks securely, pilot drilled and tapped to hold different size bushings, etc.

PROMPT DELIVERY

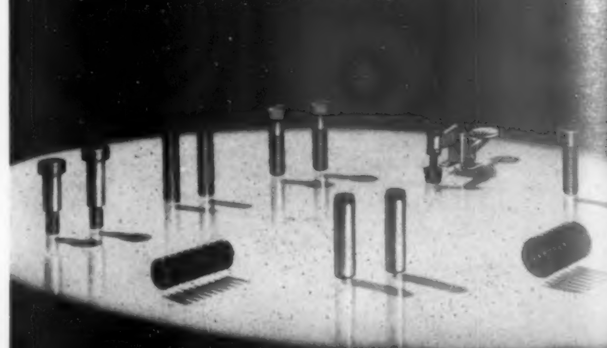
Write for Literature

PRECISION PRODUCTION TOOLS

ACME TOOL COMPANY

96 WARREN STREET • NEW YORK 7, N. Y.

Use "Detroit" Accessories for Dependability



These assembly items are known throughout industry for their quality and precision.

For quick service draw on our large stock of Dowel Pins (163 Standard sizes plus oversizes), Springs, Socket Head Cap Screws, Stripper Bolts, Set Screws and Toggle Clamps.

Standard and Special Die Sets in all sizes.

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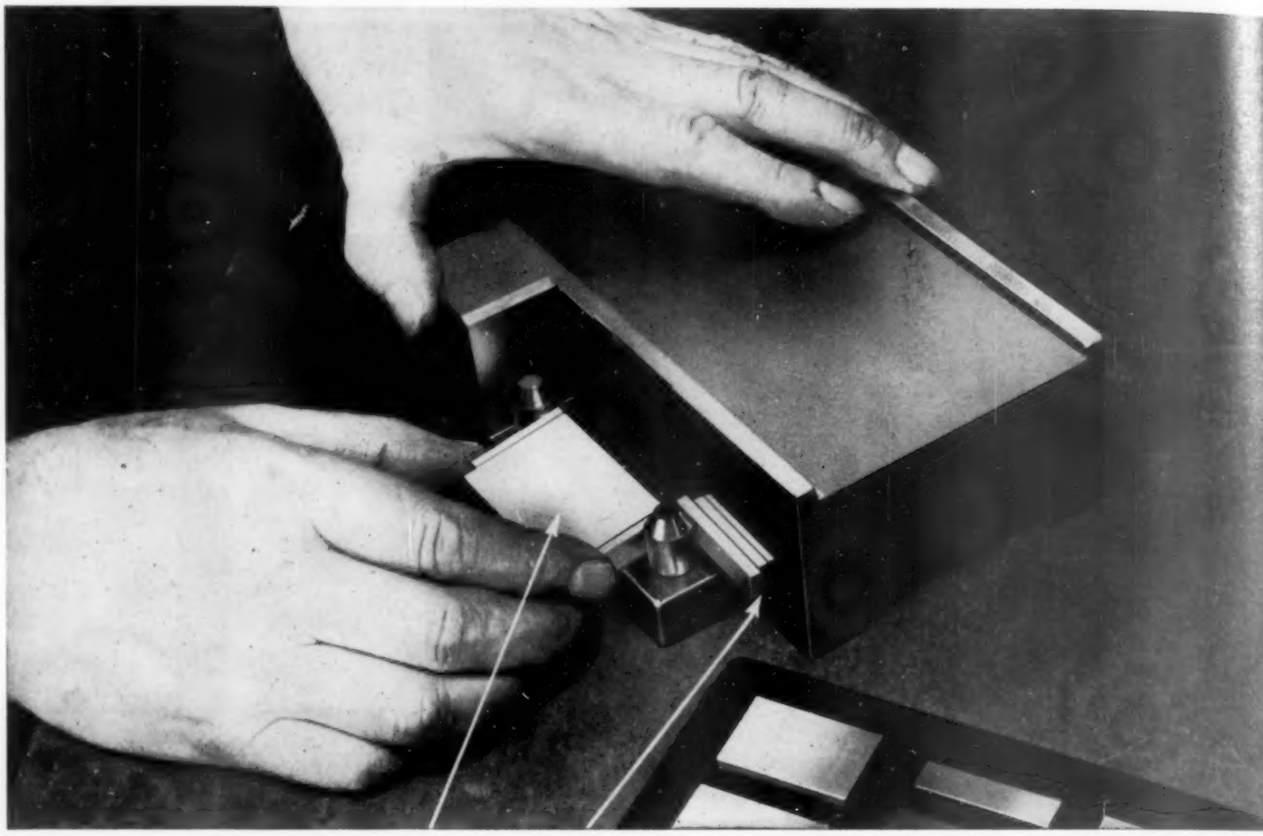
DETROIT DIE SET CORPORATION

2895 W. GRAND BLVD. • DETROIT 2, MICH.

DETROIT DIE SETS ★



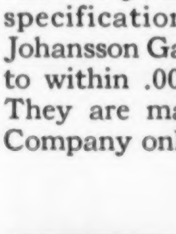
Certifying the spacing of location pins in two directions on a fixture, using proper combinations of Jo-Blocks "wrung" together.

When the Jo-Blocks say "it's right"—then it's RIGHT!

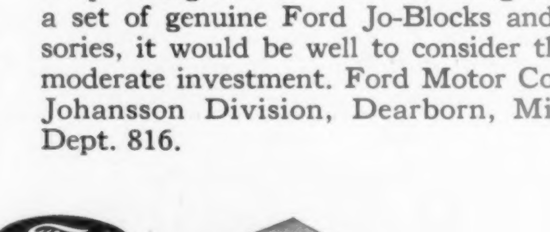
Since the hours your engineering and tool-room staffs put into a precision fixture, jig or die can so easily represent a dead loss, if a single critical dimension is incorrect, doesn't it strike you that the use of genuine, warranted Jo-Blocks is a mighty sensible precaution?

When you take a measurement with Jo-Blocks and the Jo-Blocks show the dimension is per specification . . . *that's that!* Genuine Johansson Gage Blocks are warranted accurate to within .000002", .000004" or .000008", ±. They are made in America by Ford Motor Company only. They are used by hundreds of manufacturers, as master gages to check working gages, micrometers, etc., as precision layout tools and frequently as actual working gages (since the cost of an individual Jo-Block or two is often appreciably less than that of a specially-built working gage).

If your plant—particularly your tool-room—is operating without the reassuring control of a set of genuine Ford Jo-Blocks and Accessories, it would be well to consider this very moderate investment. Ford Motor Company, Johansson Division, Dearborn, Michigan. Dept. 816.



WRITE FOR YOUR NEW COMPLETE JO-BLOCK CATALOG!



Ford

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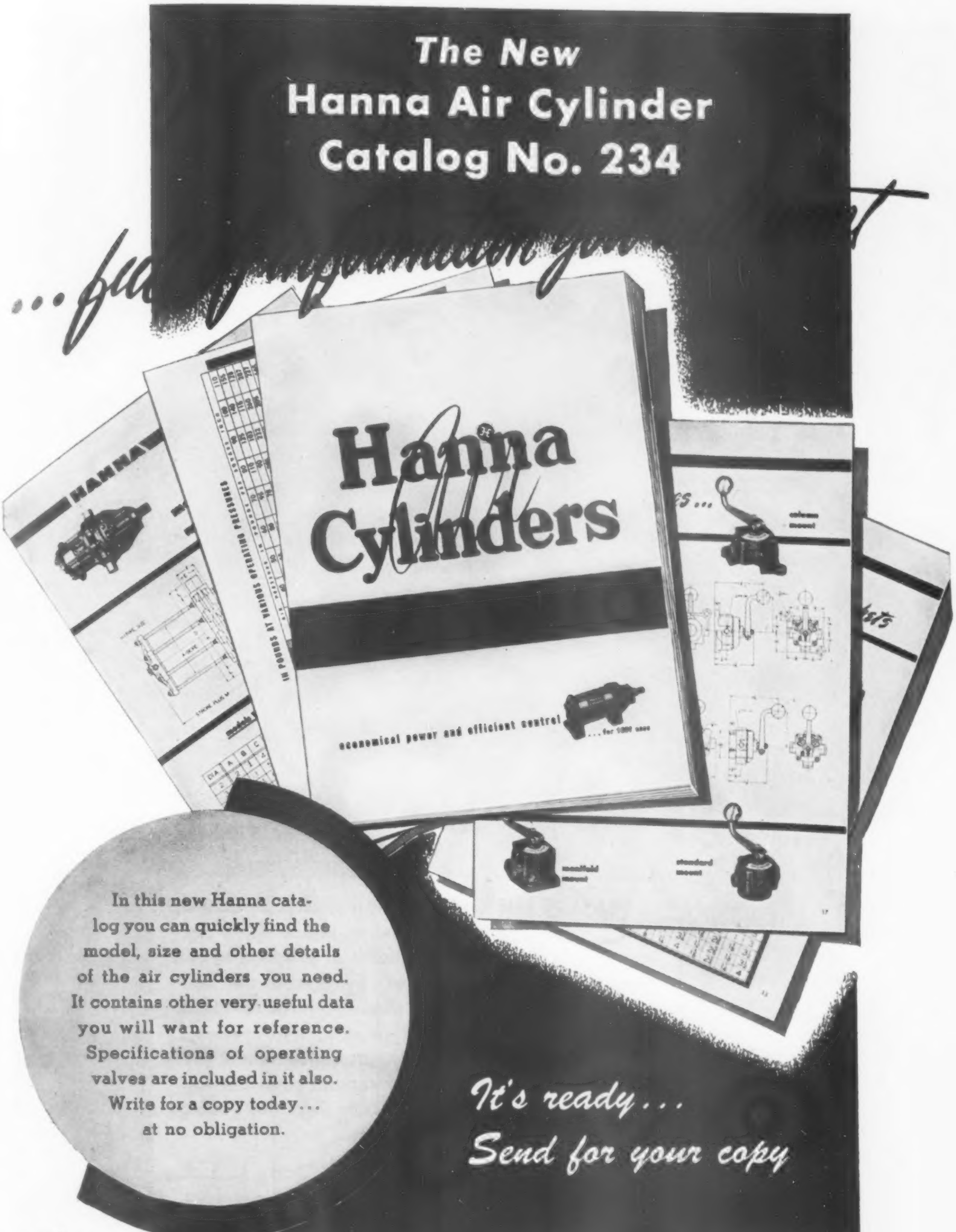
GAGE BLOCKS


The New
Hanna Air Cylinder
Catalog No. 234
Hanna
Cylinders
In this new Hanna catalog you can quickly find the model, size and other details of the air cylinders you need. It contains other very useful data you will want for reference. Specifications of operating valves are included in it also. Write for a copy today... at no obligation.
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Winter
WINTER
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Winter engineering research insures the best tool you can buy on the basis of threaded holes per tap. Insist that you get Winter Quality Taps. A leading distributor near you stocks them.
WINTER BROTHERS Co., Wrentham, Mass., U. S. A.
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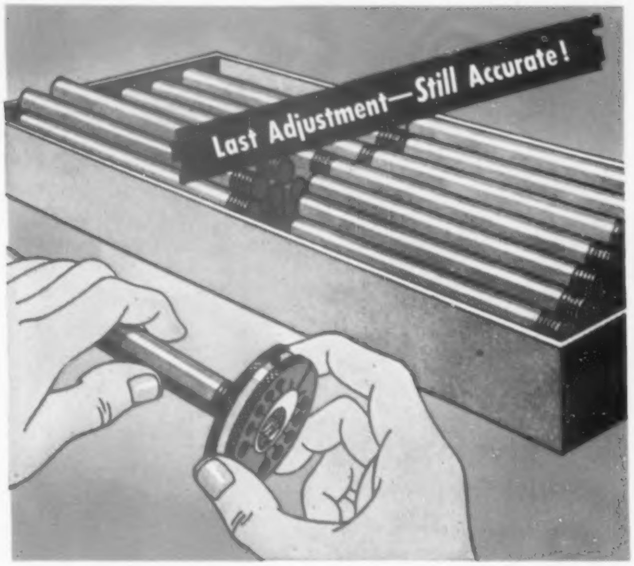
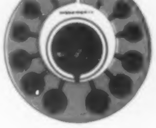


Amazing Adjustable Thread Ring Gage

Starts round  *stays round* 

5-PLUS FEATURES

1. Accurate and stable
2. Long wear life
3. Light weight
4. Positive identification
5. Positive adjustment

ACCURACY YOU CAN TRUST

A NEW WAY to cut inspection costs—shift to the New Woodworth Adjustable Thread Ring Gage.

The design of this gage gives you long life accuracy, never before possible with conventional thread ring gages. Because of the accuracy, gage life is increased many times. One large plant is getting 12½ times longer service than with the old style gages.

Think what this will mean to your inspection costs.

WRITE FOR FOLDER 46R

WOODWORTH

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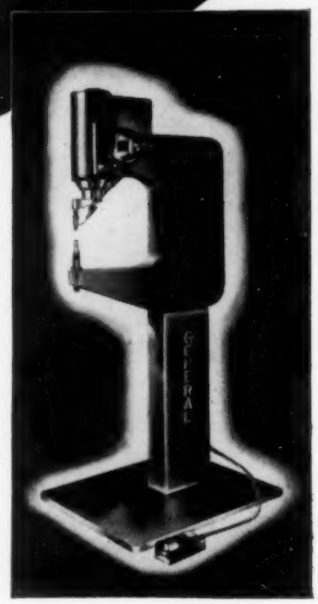
PRECISION GAGES • PRECISION MACHINED PARTS • DIAPHRAGM CHUCKS • ADJUSTABLE CLAMPING JIGS • SPECIAL TOOLS

RIVETERS
Built for YOUR Job at "STOCK-LINE" prices



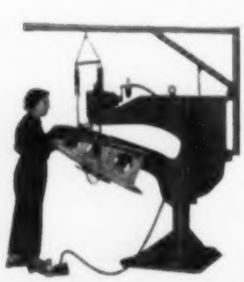
General Riveters will furnish a machine tailored to exactly fit your needs at a stock item price

THERE'S no need to pay a premium price for a special machine. If you have a riveting problem, we have the answer in a riveter especially designed for your job. Best of all, it will probably cost no more than a stock riveter.

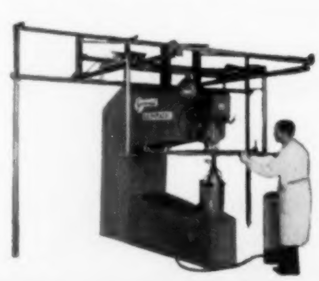
Under present conditions, many industries find it aids production, where the work permits, to use General Automatic feed riveters, equipped with indexing fixtures. They insure maximum output by setting the pace for the operators, and improve quality by reducing the human element.

Let us survey your riveting operations and recommend the best equipment for the job. There is no obligation. Simply send blue-prints or samples of parts to be riveted with a description of your present assembly procedure and production requirements. General Riveters Equipment is guaranteed, deliveries are prompt.

Pneumatic Squeezer for leading edges.



Combination Drill and Automatic Feed Hydraulic Squeezer.

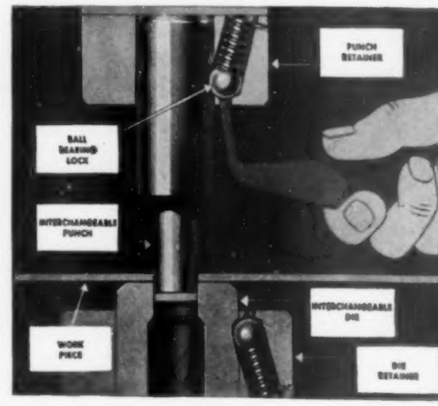


GENERAL RIVETERS INC.

formerly GENERAL ENGINEERING CO.

781 HERTEL AVE. BUFFALO 7, N.Y.

The Original
INTERCHANGEABLE PUNCH and DIE



Allied's R-B Interchangeable Punch and Die lowers costs in the metal working and plastic industries. Standard punches and dies carried in stock. Special shapes and sizes in any material made to your specifications with prompt deliveries. Send for large illustrated R-B catalog, now.

ALLIED PRODUCTS CORPORATION

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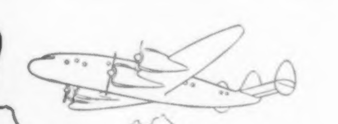

Major Airlines Standardize on STURTEVANT for accuracy

The leading airlines recognize the importance of *accurately* controlling applied torque in tightening screws, nuts and threaded parts when servicing aircraft. That is why they select the *permanently accurate* STURTEVANT TORQUE WRENCHES.

Inherently accurate—not for a few hundred or a few thousand deflections but permanently accurate for the life of the tool—STURTEVANT TORQUE WRENCHES have a tool life of hundreds of thousands of deflections.

World's Largest Manufacturer of Torque Wrenches. Capacities: from 0-8 inch ounces to 7200 inch pounds.

Write for Bulletin No. 41


These BAY STATE abrasive products, manufactured with large pore spaces are especially suitable for SURFACING and TOOL and CUTTER jobs that require extra coolness of cut and heavy, fast removal of metal.
Our sales and distributor representation is located in nearly every principal city. Let them, and us, solve your grinding problems.
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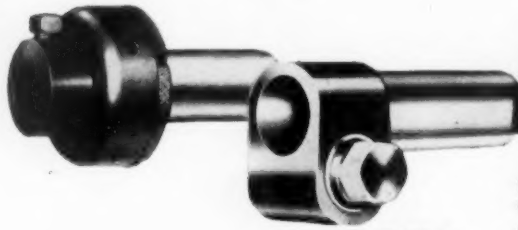
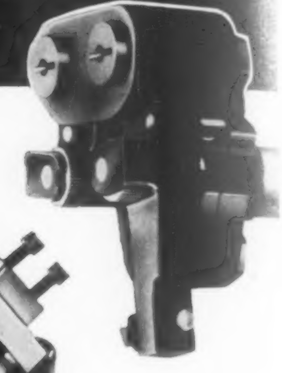
Top Performance Consistently Duplicated
BAY STATE ABRASIVE PRODUCTS CO. • WESTBORO, MASSACHUSETTS, U.S.A.

BOYAR-SCHULTZ *Full Time* SCREW MACHINE TOOLS

Less Set-up Time Less Down Time More Production





Much of the costly delay in setting up screw machine jobs can be avoided with Boyar-Schultz Screw Machine Tools. Designed with a full understanding of the problems confronting screw machine operators.

MODEL T Turning Tool.

A new, improved Screw Machine Tool designed with special emphasis on quick accurate set up for precision turning. Less down time is the result of speed in adjustment. Model T Screw Machine Tool is made in five sizes—Nos. 000, 00, 0, 2 and 3.

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Floating Tool Holder.

For reaming, counterboring and drilling to close tolerances. In 8 Sizes. No. 000—to No. 6.

MODEL H
Precision Adapter.

A permanent Tool that permits the use of more than one size screw machine tool on a given size screw machine. Made in 6 Sizes.

MODEL G
Universal Tool Bit Grinding Fixture.

Tool Bits can be accurately and uniformly ground with any desired chip clearance angles. Uniformly ground tool bits save time in set-up, save tool steel and save time in grinding.

MODEL K
Knurling Tool.

A new Screw Machine Tool of outstanding design and construction making it possible to perform many of the knurling jobs formerly considered impossible with tools of other types. Speedy in operation, giving clean, accurate knurling in a minimum of time.

Write for complete details on above tools

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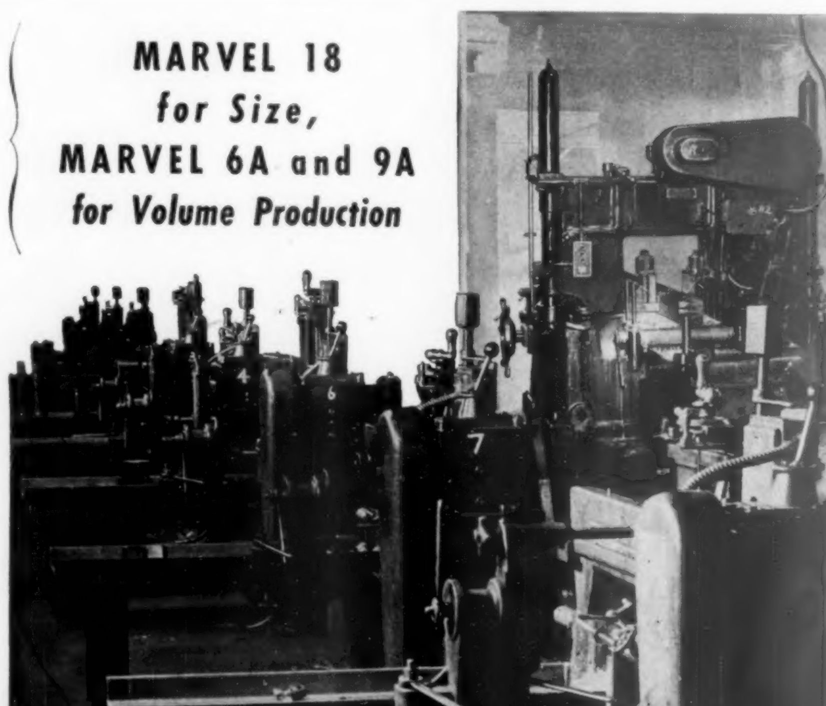
Capacity . . .

MARVEL 18 *for Size,* MARVEL 6A and 9A *for Volume Production*

With this battery of twelve No. 6A and No. 9A MARVEL High Speed Automatic Hack Saws, the Hammond & Irving Forge Co. of Albany, New York can cut-off billets automatically, not only in tremendous numbers, but in accurate weights and sizes to exactly fill each die—without waste. With 12 of the "world's fastest cutting-off saws," they were able to keep all hammers running on their tremendous war orders, and were able to instantly resume peacetime manufacturing without re-tooling or other delay. The No. 6A and No. 9A MARVEL automatics have capacities of 6" x 6" and 10" x 10" respectively.

In addition to the battery of MARVEL Automatics, Hammond & Irving have cutting-off *capacity* of a different sort in their MARVEL No. 18 Hydraulic Hack Saw — capacity for size — because this roll-stroke giant cuts off billets and bars in sizes to 18" x 18" cross section. It easily handles the toughest and hardest steels.



ARMSTRONG-BLUM MFG. CO.
"The Hack Saw People"
5700 BLOOMINGDALE AVE. • CHICAGO 39, U.S.A
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SIMONDS gives you the right Band Saw to deliver Top Output and Economy in cutting any type of Metal or Plastic

1. REGULAR HARD EDGE BAND SAWS

Simonds Steel Mills produce a special tough alloy steel for these saws. Teeth are sharp, perfectly milled, and set even on both sides of blade, to give clean, easy cutting and long saw life. And joints are welded for equal strength with rest of blade.

2. SKIP-TOOTH BAND SAWS

Here's the extra gullet-capacity for large chips from aluminum, magnesium, plastics and wood. These saws stay sharp so long that it's economical to replace them and save resharpening. They have the same hardened tooth-edge as the Regular Hard Edge Saws. Made in widths from ⅛" to 1" Tooth-spacings: 2, 3, 4, and 6 per inch.

3. SPRING TEMPER BAND SAWS

Especially successful in sawing thin sheet aluminum, magnesium, and steel . . . also brass, light structural shapes, plastics, fibre, non-ferrous tubing and similar materials. These blades cut for exceptionally long periods without dulled teeth . . . and then they are quickly reset and filed and put back on the machine.

Consult your Industrial Supply Distributor about the best type and specification of Simonds Band Saw for *your* work. Or write the nearest Simonds office.

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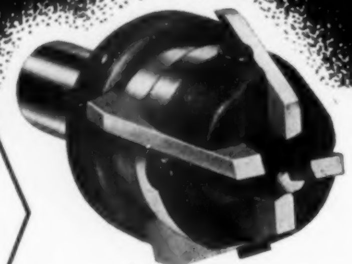
ADJUSTABLE HOLLOW MILLS WILL INCREASE YOUR PRODUCTION



STYLE M • Blades set at rake angle for cutting steel, aluminum, and other materials requiring rake.

INSERTED BLADE FACING & COUNTERBORING TOOLS

SPECIAL HIGH PRODUCTION TOOLS

• THERE IS A GENESEE for every hollow milling job. Available in 16 styles. Standard sizes from 0 to 2", with straight or Morse taper shanks carried in stock . . .

- Each size tool has 1/8 range.
- Blades quickly ground in a simple fixture.
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- Available with high speed steel, cast-alloy, or Tungsten Carbide tipped blades.

Genesee Tools will increase your production—35 years of know-how is yours for the asking . . . Write for complete catalog No. 45.

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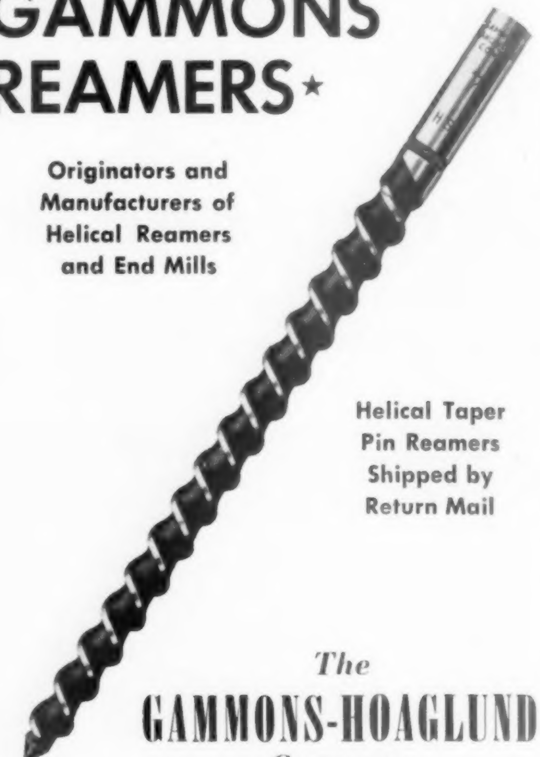
GAMMONS REAMERS★

Originators and Manufacturers of Helical Reamers and End Mills



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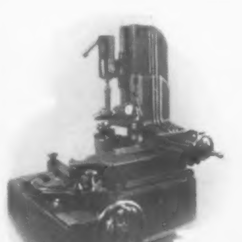
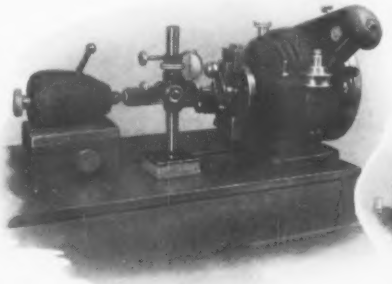
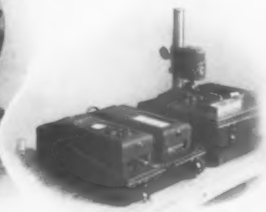
Call Detroit Broach for complete broach service that is right from design to actual production.



Involute Checker for checking involute tooth form.



Optical Dividing Machine for checking index.



Surface Analyzer for checking tool and broached part finish.

Optical Comparator for checking irregular forms.

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CYLINDER GAUGE #30 WITH SETTING HANDLE
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SPEEDIER, SIMPLER, SURER INSPECTION

Small threaded work or large unwieldy pieces are inspected faster, easier, and *with master gage accuracy* on Bryant Thread Gages. Two types, Bench and Portable, will check internal and external threads up to 8" and 3" respectively—the Portable Gage being ideal for inspection of internal threads in heavy castings, or work still chucked in the machine. Both gages employ the new Bryant principle of three point contact (two stationary thread segments—one retractable segment) and visual accuracy indication. Bryant Gages eliminate redious threading, thereby increasing segment life and doing away with the groping "feel for fit" on the part of the inspector. They are so easy to operate that even a novice can become proficient in less than a day. In fact, all he has to do is press a lever, engage the segments, give the part or gage a partial turn and watch the dial indicator—immediately, size, presence of burrs, accumulated inaccuracies of pitch, lead, diameter and thread form are indicated. The Bryant Method of inspection is at least four to five times faster than the ring and plug gage system.

Are you interested in a speedier, simpler and surer inspection method for your threaded parts? Use the coupon below for complete details on Bryant Bench and Portable Thread Gages. This little effort now may save you hundreds of dollars in the future.

at the bench
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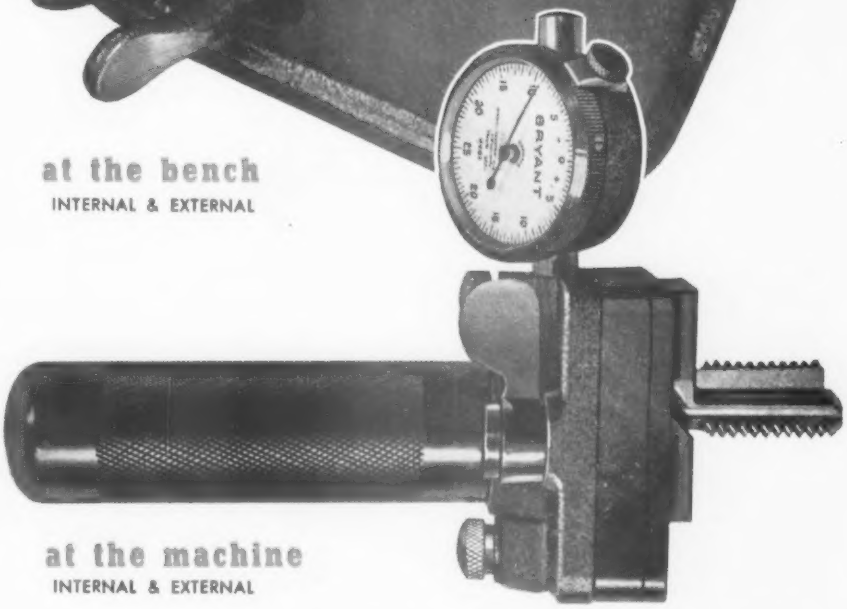

at the machine
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Also Manufacturers of Squareness of Face Gages and Universal Diameter Size Gages —plus a complete line of internal grinding machines.

Please send me Catalog No. G3 which gives complete details on the Bryant Thread Gages.

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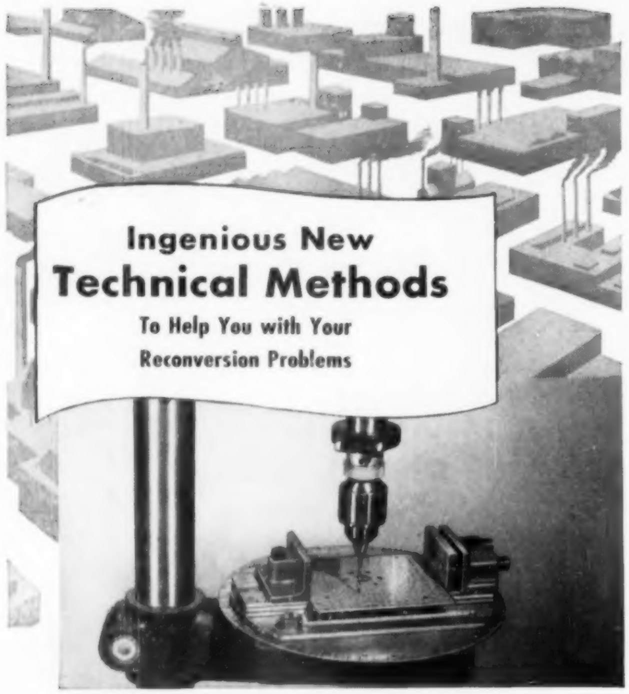
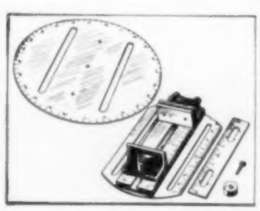
BRYANT

BRYANT CHUCKING GRINDER CO. SPRINGFIELD, VERMONT, U. S. A.



New, Simplified Drill Press Vise, Speeds Up Drilling, Spacing, Milling

Designed to be used with a drill press table having either parallel or radial slots, the New UNI-VISE drill press vise, with guide bar and protractor disc, speeds up and simplifies drilling, layout and spacing work in straight lines, radial or circular. With two movable jaws, vise has universal movement without swinging table or head of drill press to locate exact position of work. Operator thus adjusts work quickly for accurate registration.



Guide Bar facilitates drilling holes in a straight line. With a straight edge and a lineal scale on surface, it registers with lineal scale of vise. Protractor disc, for drilling holes accurately in a circle, has parallel slots registering with parallel slots in base of vise, and a removable means to pivot complete unit on table of drill press.

Accurate work can always best be done by attentive operators. That's why many factories urge workers to chew gum. The chewing action helps relieve monotony—helps keep workers alert, thus aiding them to do a better job with greater ease and safety. And workers can chew Wrigley's Spearmint Gum right on the job —even when hands are busy.

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STANDARD AND .001 OVERSIZE

Hardened and Precision ground to a tolerance of ± .0001 of an inch. Available in .001 oversize for repair or renewal work.

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- NO MUSHROOMING
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The longer life of chromium plated gages more than makes up for their high first cost and results in worthwhile net savings.
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The insert can be installed in any bar available by a simple boring and milling operation. The locating head of the boring-bar insert fits snugly into the recessed slot of the bar. The set screw in the boring bar locates the insert and draws the head firmly against the shoulder of the recessed slot in the bar. Accurate location point is always maintained. *The Nash-Zempel boring-bar insert is available in forty standard sizes, with special sizes on request.*

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Division of J. M. Nash Company

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LOW production costs are absolutely essential today. And the way to get down to minimum on surface grinding costs is to let a Norton engineer study each of your jobs. He can furnish a grinding wheel or segments for **every** type of surface grinder — and with the grinding action "tailored" to fit your particular requirements.

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4. **HORIZONTAL SPINDLE —** *Straight Wheel* **ROTATING TABLE**
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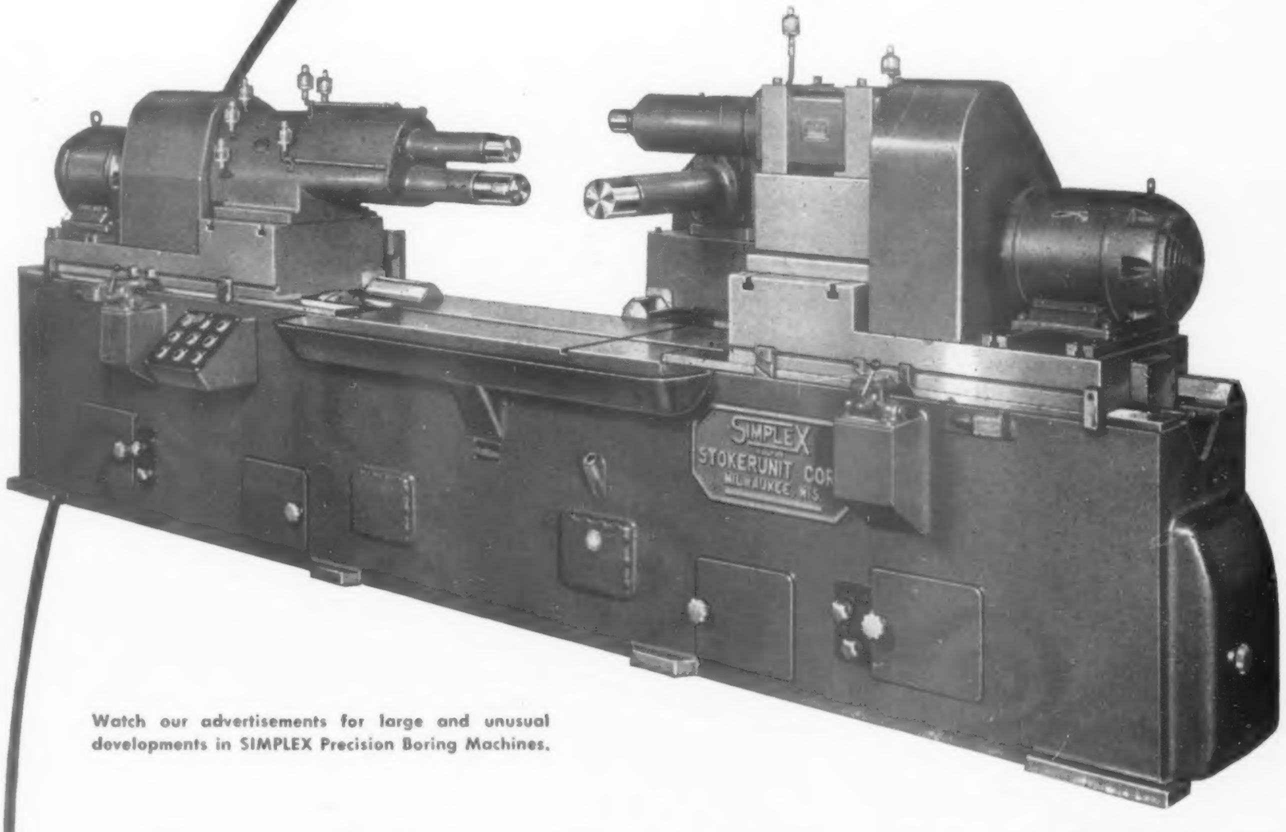

Watch our advertisements for large and unusual developments in SIMPLEX Precision Boring Machines.

Precision Boring Machines

STOKERUNIT CORPORATION

SIMPLEX Precision Boring Machines and Planer Type Milling Machines

4528 West Mitchell Street, Milwaukee 14, Wisconsin

Index of Tool Engineer Advertisers

August, 1946


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with positive jaw feed clutch.
3. QUIET, POWERFUL HEADSTOCK
with three bearing spindle.
4. THRUST LOCK TAILSTOCK
automatic, foolproof control.
5. REVERSE TO LEADSCREW
saves time and motion.
LEBLOND
12" 14" 16" 18"
Tool Room LATHES
BULLETIN NO. T-70

Model 49

NEW BRITAIN-GRIDLEY MACHINE DIVISION